# ATTACHMENT 8

Superfund Record of Decision: Hardage/Criner, OK
(EPA/ROD/R06-90/054)
November 1989

PB90-220633

United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R06-90/054
November 1989

EPA

# Superfund Record of Decision:

## Hardage/Criner, OK

EPA/ROD/R06-90-054
Hardage/Criner, OK

16. Abstract (Continued)

and ground water are VOCs including benzene, PCBs, PCE, TCE and other carcinogenic compounds; other organics including pesticides; and metals including arsenic, chromium, and lead.

The selected remedial action for the site includes source control and ground water components. Source control remediation includes installation of liquid extraction wells to pump out free liquids currently pooled in the three waste areas and any liquids released from drums buried in the mounds, followed by offsite treatment of the removed organic liquids and onsite treatment of aqueous liquids; excavation of drummed organic liquids for offsite destruction; excavation and consolidation of contaminated soil adjacent to the main source areas with placement in the main source areas, followed by temporary capping; treatment of the main source areas using in-situ soil vapor extraction with treatment of air used in soil extraction by thermal destruction; installation of a permanent RCRA-compliant cap once remedial activities are complete. Ground water components are designed to control the spread of ground water plumes and protect downgradient areas because of the technical impracticability of restoration of the bedrock aquifer. Ground water remediation includes installation of an interceptor trench downgradient of the source areas to intercept and collect contaminated ground water migrating in bedrock zones, and a second trench or equally effective system of extraction wells to intercept and collect contaminated ground water contaminating the alluvium; design and construction of an onsite ground water treatment system to treat both organic and inorganic contaminants before discharge of treated water to surface water. Contaminants already present in the alluvium will be allowed to dissipate by natural dilution, natural attenuation, and flushing; however, active restoration will be implemented if contaminant reduction goals are not met. In addition, institutional controls, surface water controls, and multimedia monitoring will be implemented, and the current provision of an alternate water supply will be continued. The estimated present worth cost of this remedial action is $62,904,655, which includes an annual O&M cost of $1,300,000.

ATTENTION

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RECORD OF DECISION AMENDMENT
HARDAGE/CRINER SITE
McCLAIN COUNTY, OKLAHOMA
NOVEMBER 1989

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 6, DALLAS, TEXAS

1.C

DECLARATION
FOR THE
RECORD OF DECISION AMENDMENT

SITE NAME AND LOCATION

Hardage/Criner
McClain County, Oklahoma

STATEMENT OF BASIS AND PURPOSE

This decision document represents the selected remedial action for the Hardage/Criner site developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

This decision is based on the contents of the administrative record for the Hardage/Criner site. The attached index (Appendix C) identifies the items which comprise the administrative record upon which the decision to amend the 1986 Record of Decision (ROD), and the selection of the modified remedial action is based.

The State of Oklahoma supports a number of the components of the amendment but has not concurred with all elements of the selected remedial action.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from the site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE REMEDY

The 1989 proposed remedy is a comprehensive site remedy addressing both Source Control and Groundwater operable units at the Hardage/Criner site. It involves a modification of the 1986 ROD for Source Control, and incorporates new Groundwater response actions. The major components of this remedial action consist of the following source control and groundwater components:

SOURCE CONTROL

- the installation of liquid extraction wells in three main source areas to pump out free liquids current y pooled in these areas and any liquids released from drums buried in the mounds. The liquids would be collected and shipped offsite for treatment, thereby permanently reducing the volume of haz -dous substances in the source areas and the potential for the r migration.

- o excavation as per the 1986 ROD for the direct removal of drummed liquids in the Barrel Mound and Main Pit. Drum excavation and liquids removal would reduce the volume of hazardous liquids within the source areas during the early phases of remedy implementation, thereby reducing the reliance on long-term active controls otherwise necessary to address the continued release and migration of hazardous liquids, many of which are highly toxic, resulting from gradual and difficult to predict corrosion of drums.

- o excavation of contaminated soils in areas adjacent to the three main source areas and transport to the source areas. These materials would be consolidated under a temporary cap in the main source areas where they would be treated using soil vapor extraction.

- o use of soil vapor extraction to draw air through the source areas after consolidation to evaporate contaminants and permanently remove them to the surface through air extraction wells. The air would be treated to destroy the contaminants using the best available control technology (BACT) by thermal destruction.

- o permanent source area capping once remediation activities are complete. A temporary cap will be installed during remediation activities, followed by a permanent RCRA-compliant cap at the end of remediation.

GROUNDWATER

Groundwater components summarized below would be implemented in conjunction with a substantial reduction of the contaminant source areas thereby reducing the long-term potential contribution of the sources to groundwater.

- o the installation of a V-shaped trench located downgradient (west, south and east) of the three main source areas to intercept and collect contaminated groundwater migrating in all bedrock zones existing above Stratum IV. This trench would capture contaminated groundwater onsite and near the source areas minimizing migration of contaminants beyond the trench and into the alluvium of North Criner Creek.

- o the installation of an interceptor trench, or equally effective system of extraction wells, in the southwestern part of the site to contain contaminated groundwater moving into the alluvium from bedrock zones above Stratum IV. This interceptor system would capture migrating contaminants between the V-trench and alluvium of North Criner Creek.

- o the design and construction of an onsite groundwater treatment system incorporating treatment processes to treat both organic and inorganic contaminants to surface water discharge standards. Collected groundwater would be pumped to the treatment unit, and the treated water discharged to North Criner Creek.

- alluvial groundwater restoration. Contaminants already present in the alluvium would be allowed to dissipate by natural dilution, natural biodegradation and flushing. The interceptor trenches, in conjunction with source control actions, would abate contaminant migration into the alluvium of North Criner Creek and allow natural restoration to Maximum Contaminant Levels to occur. If alluvial monitoring reveals that estimated natural restoration times and plume dilution rates are not being met, then active restoration of the alluvium would be implemented. An increase in contaminant concentrations in the alluvium after trench installation and pumping, or a decline in the mass of contaminants of less than 40 percent in 10 years, will trigger active restoration in the alluvium.

In addition to the Source Control and Groundwater components listed above, the comprehensive remedy calls for the following monitoring and support components (further described in Section 6) which are necessary as part of remedy implementation:

- institutional controls, including fencing, deed restrictions, and maintenance of the availability of an alternate water supply system. These will be implemented to restrict access to the site and contaminated groundwater.

- surface water controls to collect surface water drainage from the source areas during remedy implementation, and to divert uncontaminated runoff away from the working area in order to minimize the generation of contaminated groundwater.

- remedial monitoring to verify that the migration of contaminants has been halted. This monitoring program includes monitoring of surface water in North Criner Creek, monitoring of alluvial and bedrock groundwater onsite and offsite, including downgradient of the alluvial contamination plume, and monitoring of the performance of the groundwater interceptor trenches (or wells if used in place of the southwest interceptor trench) to determine their effectiveness in containing and reducing contamination. The caps proposed as part of the Source Control will be monitored for differential settlement or erosion. Finally, air quality would be monitored during implementation of the remedy both onsite and at the fenceline boundary. Action levels will be set onsite to assure that Maximum Ambient Air Concentrations are not exceeded at the fenceline.

DECLARATION

The selected remedy, if implemented, is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate to this remedial action and is cost-effective.

This remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility or volume as a principal element and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

Because this remedy will result in hazardous substances remaining onsite above health based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Robert E. Layton Jr.

Robert E. Layton Jr., P.E.

Nov. 22, 1989

Date

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## 1.0 SITE LOCATION AND DESCRIPTION

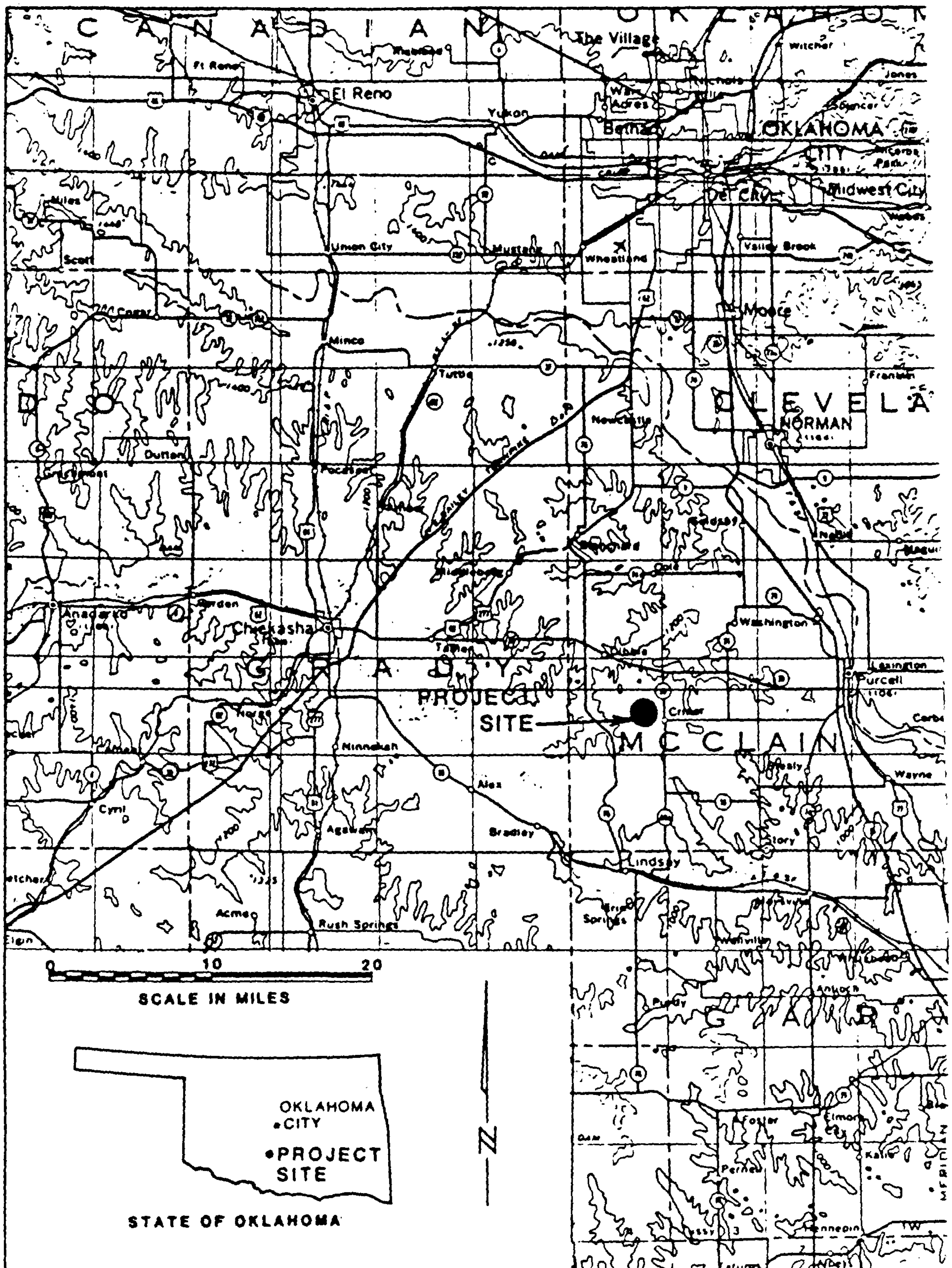
The Hardage site is located in a rural area of McClain County in central Oklahoma, approximately 25 miles south-southwest of Oklahoma City (Figure 1-1). The site is bounded on the South by old Oklahoma State Highway 122, on the north by open farmland, on the west by a gravel (County) road, and on the east by a series of three small ponds (Figure 1-2).

The Hardage site was operated from 1972 to 1980 under a permit issued by the Oklahoma State Department of Health (OSDH) for the disposal of industrial wastes. In 1983, EPA placed the site on the "National Priorities List" (48 Fed. Reg. 40658) for response under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). EPA has taken the lead in response to this site. OSDH has provided technical support and advice to EPA, particularly in the early stages of work on the site, and has been consulted on remedy selection.

As a result of waste disposal practices at the site, chemicals have migrated vertically and laterally resulting in the contamination of approximately 70 acres of groundwater beneath and adjacent to the site as well as several acres of surface soil in the immediate vicinity of the main disposal areas. The principal source of contamination is some 278,000 cubic yards of sludges, waste drums, highly contaminated soils, and waste liquids contained in three waste areas near the center of the property.

The disposal areas at the site were a number of permanent and temporary impoundments into which a variety of liquid, sludge, and solid wastes were disposed and mixed. These areas, described more fully in Section 2.1, were primarily the Main Pit, Sludge Mound, and Barrel Mound, and in addition the North Pit, West (mixing) Ponds, and East (mixing) Ponds (see Figure 1-2). During 1980 - 1981 the operator consolidated wastes into the Main Pit, Barrel Mound, and Sludge Mound and capped those areas with two to three feet of local soil in an effort to permanently close the site. Closure efforts failed, however, to prevent the migration of hazardous substances vertically and laterally into groundwater from the impoundments. More specifically, dense non-aqueous phase liquids have pooled beneath the Main Pit, Barrel Mound and to some extent the Sludge Mound and now serve as a continuing source of contamination to the groundwater. Volatile organic compounds, many of them known or suspected carcinogens, have migrated from these areas offsite into the alluvium of North Criner Creek, forming a plume of contamination extending a distance of about 2800 feet southwest of the Main Pit. Total concentrations of volatile organic compounds in the plume exceed 25,000 ppb near the source areas and decrease systematically away from the source areas, with concentrations as high as a few hundred ppb more than 2500 feet away from the Main Pit to the southwest. Volatile organic compounds are entering North Criner Creek at sufficient quantities to cause detectable concentrations in surface water in the Creek.

Present and near-term risks are related primarily to groundwater resources and any individuals who might use the contaminated groundwater. Over the long-term, risks will also be posed due to erosion of wastes and their gradual surface and subsurface migration across and from the site.




| TEX27785.B0 | HARDAGE INDUSTRIAL WASTE SITE REMEDY COMPARISON REPORT | VICINITY MAP | FIGURE 1-1 |
|---|---|---|---|

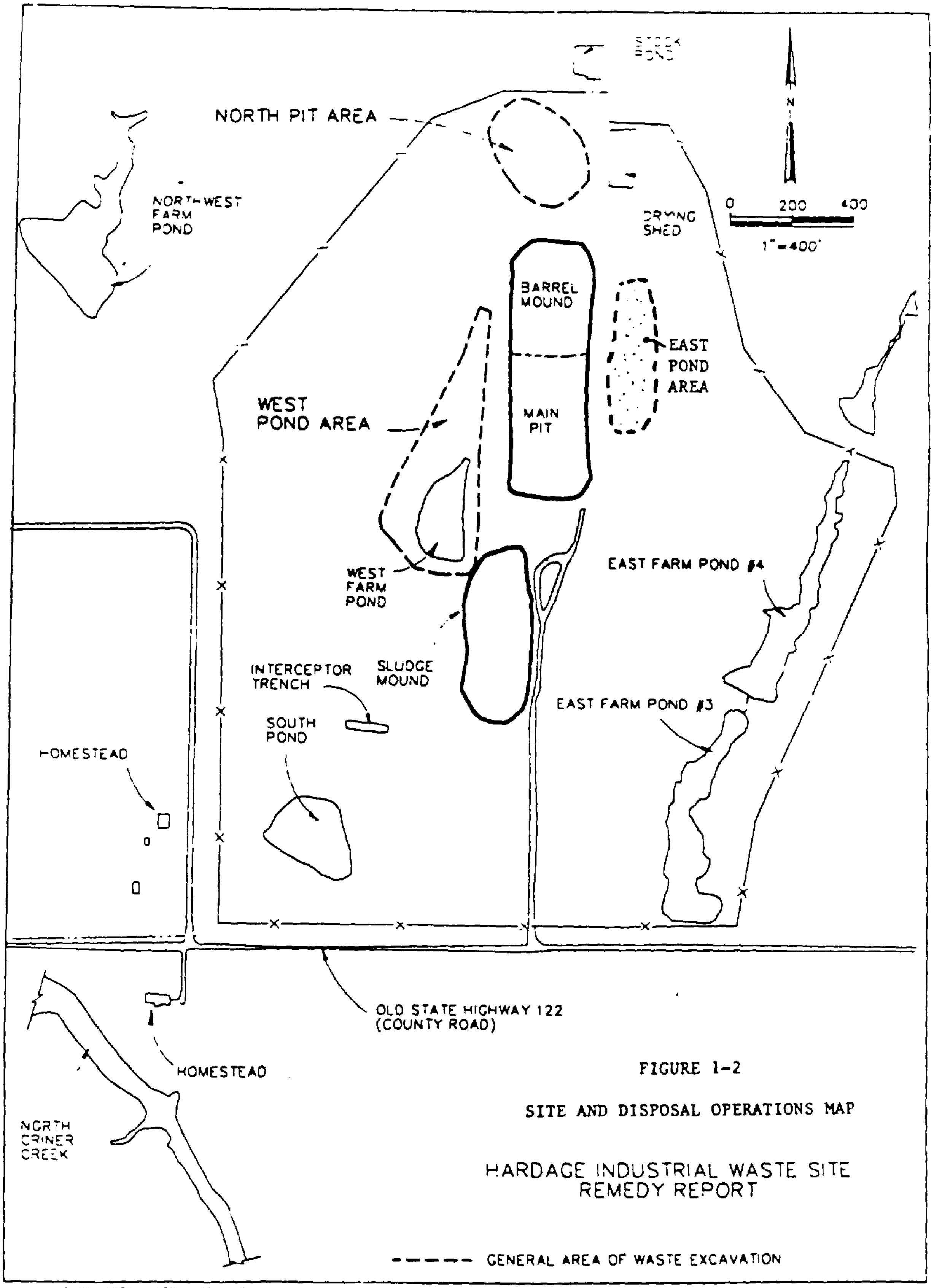



FIGURE 1-2

SITE AND DISPOSAL OPERATIONS MAP

HARDAGE INDUSTRIAL WASTE SITE
REMEDY REPORT

## 2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

### 2.1 Disposal Operations

In 1972 the site owner and operator Royal Hardage, received a permit from the Oklahoma State Department of Health (OSDH) to operate a hazardous and industrial waste landfill at the site. This permit was based on an application by Mr. Hardage that consisted of a general outline of planned operations and limited subsurface boring data on site geology.

From September 1972 until November 1980 the site accepted approximately 21 million gallons of hazardous and industrial wastes including paint sludges and solids, ink solvents, tire manufacturing wastes, oils and solvents such trichloroethene, corrosives, plating wastes sludges, cyanides, and caustic wastes, many of which are now regulated as hazardous waste under the Resource Conservation and Recovery Act (RCRA). The liquid portion of this waste was initially discharged into the Main Pit. Early in the operation, problems began to occur due to slower than expected evaporation of wastes. To deal with this problem, the operator began spraying liquids over the Main Pit to enhance evaporation and also drained some of the liquids into adjacent temporary mixing ponds for bulking with soil. The soil/waste mixture was disposed in a new area called the Sludge Mound. Sludge waste, including residue from oil recycling and styrene tar production, and some drums of solid material, were also disposed in the Sludge Mound.

In addition to the bulk waste liquids disposal described above, drums of waste were also received at the site. These waste drums were initially opened and dumped into the Main Pit. This practice, however, became less common after about 1974. During most of the operations, drums were dumped off trucks into two areas, the west side of the Main Pit and the Barrel Mound. The Barrel Mound area adjoins the north end of the Main Pit and was built to a height of 25 to 30 feet by trucks dumping drums off of the south side of the mound, filling soil over and around the drums, and dumping of additional drums onto the previously dumped drums. Many of the drums at the site were carelessly dumped into the pits, without any attempt to avoid rupturing. Some drums were rolled off trucks down the face of the Barrel Mound. Other drums dumped into the pits were not sealed to begin with. As a result, a substantial number of these drums spilled or broke open during the disposal operation resulting in the direct release of large volumes of hazardous and carcinogenic chemicals into soils and eventually groundwater. Many of the drums, however, were disposed intact, as shown by accounts of the site operation (Hardage, 1987). Moreover, intact drums were excavated and removed from the site during exploratory excavations in 1988 (EPA, 1988). A summary of drummed wastes brought to the site (from manifests) is presented in Table 2-1.

In addition to disposal practices in the source areas (Barrel Mound, Main Pit, and Sludge Mound) waste mixing and transfer operations were conducted over much of the site in areas known as the North Pit, East Pond area, and West Pond area. The disposal areas and site activities described above are illustrated in Figure 1-2.

Table 2-1
SUMMARY OF DRUMMED WASTES FROM MANIFESTS

| Waste Category | No. of Containers Received | Estimated Volume Received(1) (gallons) |
|---|---|---|
| Paint | | |
| Sludge | 5,897 | 324,047 |
| Paints and Related Wastes | 1,044 | 57,420 |
| Solids | 451 | 24,805 |
| Mixed Wastes | | |
| Mixed Wastes | 2,557 | 138,600 |
| Tire Manufacturing Wastes (Carbon Black, Soap, Oil, Solvents, Rubber) | 1,405 | 77,275 |
| Soap, Oil, Solvents | 304 | 16,720 |
| Acid | | |
| Rinse Water | 1,867 | 102,685 |
| Sulfuric Acid | 880 | 48,400 |
| Sludges | 676 | 37,180 |
| Acids | 341 | 18,755 |
| Chromic Acid | 248 | 13,565 |
| Nitric Acid | 194 | 10,670 |
| Acids and solvents | 31 | 1,705 |
| Muriatic Acid | 13 | 715 |
| Acrylic Acid | 12 | 660 |
| Hydrofluoric | 4 | 220 |
| Oils and Solvents (TCE, Stoddard) | 3,253 | 177,815 |
| Asbestos | 1,345 | 73,975 |
| Oil | | |
| Oils | 660 | 36,300 |
| Sludge | 132 | 5,790 |
| Alumina Silica Slurry | 747 | 41,085 |
| Ink | | |
| Inks | 520 | 30,425 |
| Solvent | 57 | 3,135 |
| Sludge | 47 | 2,585 |
| Caustic | 580 | 31,900 |

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Table 2-1
(continued)

| Waste Category | No. of Containers Received | Estimated Volume Received[1] (gallons) |
|---|---|---|
| Cupric Ammonium Persulfate and Toxic Tin | 435 | 23,925 |
| Corrosive | 357 | 19,635 |
| MDI (methylene bisphenyl isocyanate) | 299 | 16,325 |
| Plastic Wastes | 261 | 14,355 |
| Aromatic Residue | 232 | 12,760 |
| Chemical Wastes | 229 | 12,595 |
| Plating Waste Sludge | 214 | 11,770 |
| Cyanide (Copper, Potassium, Sodium) | 142 | 7,760 |
| Shopwaste | 111 | 6,105 |
| Nitric Alumina | 91 | 5,005 |
| Glue | 84 | 4,620 |
| Alumina Oxide | 80 | 4,400 |
| Filter Cake | 80 | 4,400 |
| Methanol | 80 | 4,400 |
| Sediment Pit Waste | 62 | 3,410 |
| Zinc, Arsenic | 33 | 1,782 |
| PCBs | 29 | 1,595 |
| Laboratory Chemical Packs (Phosgene Gas Canister, Reagents, Waste Chemicals) | 27 | 1,385 |
| Toxaphene | 145 | 1,375 |

CVOR211/033.50/2

Table 2-1
(continued)

| Waste Category | No. of Containers Received | Estimated Volume Received(1) (gallons) |
|---|---|---|
| Polyacrylamide | 14 | 770 |
| Sand Filter Sludge | 11 | 605 |
| Ammonium Bifloride | 8 | 440 |
| Selenium | 8 | 440 |
| Emulsion | 6 | 330 |
| Trichloroethene and Aluminum | 63 | 315 |
| Chromium | 20 | 300 |
| Waste Chlorides | 142 | 142 |
| Insecticides | 3 | 165 |
| Salt Sludge | 2 | 110 |
| Ammonium Hydroxide | 55 | 55 |
| Chlorine | 1 | 55 |
| Sodium Lead Alloy | 1 | 28 |
| 2,4-Dinitrophenyl Hydrazine | 1 | - |
| Pesticide with Arsenic | 1 | - |
| Vaccine | 1 | - |
| TOTAL | 25,593 | 1,437,809 |

(1) Unless indicated on manifest, Hardage (1972-1980) containers were assumed to be 55-gallon drums. All containers were assumed to be full.

2.2 Enforcement

In 1979, OSDH and EPA inspections and sampling of the site indicated waste management practices were posing potential threats to public health and the environment. In September 1980, the United States, on behalf of EPA, filed a complaint in the U.S. District Court for the Western District of Oklahoma. The complaint sought injunctive relief under Section 7003 of RCRA for the proper cleanup and closure of the site. The facility ceased operations in early November 1980, before Interim Status Standards under the RCRA came into effect.

In 1982, United States amended the existing complaint against the facility owner and operator Royal Hardage, to request relief under Sections 106 and 107 of the CERCLA. In December 1982, the Court found that the site posed an "imminent and substantial endangerment to public health and welfare and the environment" as defined by CERCLA Section 106 and RCRA Section 7003. In August 1983, the Court granted a partial judgment for over $211,000 in response costs, which EPA had incurred through 1982, against Royal Hardage. Hardage filed for bankruptcy in 1983 and again in 1985, and EPA has to date not recovered its partial judgment.

In December 1984, EPA mailed letters to 289 Potentially Responsible Parties (PRPs) requesting information about their waste disposal at the Hardage site under authority of Section 104(e) of CERCLA and Section 3007 of RCRA and notifying the PRPs of their potential liability for site cleanup. As further information was gained, information request and notice letters were sent to additional PRPs identified. At the present time, over 400 PRPs have been identified. Various PRPs have gone out of business or cannot be located; therefore, approximately 340 have been contacted. A group of these parties organized into the Hardage Steering Committee (HSC) and met with EPA and OSDH on numerous occasions concerning the site. Initial meetings with the HSC were held in January of 1985.

In May 1985, EPA released a report entitled Field Investigation and Data Summary Report (DSR) for the Royal Hardage Waste Disposal Site (EPA, 1985) documenting investigations conducted in 1984 and earlier. This document served as a remedial investigation (RI) report for the site.

After completion of the DSR, EPA determined that sufficient data were available to develop a remedy for the contaminant source areas, but that the information was inadequate to develop remedial alternatives for the contaminants that had already migrated from the source areas into groundwater. Accordingly, selection of a comprehensive alternative for a complete remedial action, addressing surface and subsurface contamination beyond the source areas, was not possible at that time. The need for control of the source areas at the site prompted EPA to consider alternatives that would reduce or eliminate the spread of contaminants off the site. Therefore, EPA decided, in accordance with Section 300.68(c) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), to divide the remedial process of the site into two operable units: 1) Source Control and 2) Management of Migration (groundwater).

During 1985, EPA began preparing a Feasibility Study (FS) for the Source Control Operable Unit primarily addressing the three principal waste source areas: the Main Pit, the Barrel Mound and the Sludge Mound.

EPA's FS, entitled Feasibility Study - Source Control - Royal Hardage Industrial Waste Site Near Criner, Oklahoma (EPA, 1986a), presented the methodology used to develop several remedial action alternatives for the Source Control Operable Unit. The alternatives, further discussed in Section 6, were evaluated in accordance with the NCP, and four alternatives were developed in detail. These four alternatives included onsite waste stabilization with disposal in a RCRA-compliant landfill, onsite incineration and disposal, offsite incineration and disposal, and onsite waste stabilization and disposal in an offsite RCRA-compliant landfill.

In November 1986, EPA issued its Record of Decision (ROD) outlining the selected final remedy for the Source Control Operable Unit (see Appendix F). This remedy was selected in a manner consistent with CERCLA, as amended, and the NCP as the most appropriate remedy for source control considering all relevant selection criteria. The selected remedy consisted of excavating, treating, and disposing of solids in a RCRA-compliant onsite landfill; removal and offsite incineration of free organic liquids; and the onsite treatment and disposal of other water-based liquid wastes. After potentially responsible parties declined to implement the selected remedy, EPA subsequently initiated the remedial design process with the design-related field activities. The detailed design was presented in EPA's Design Report - Source Control Remedial Design - Hardage Industrial Waste Site - Criner Oklahoma (EPA, 1988).

Prior to EPA's 1986 ROD, additional field studies were initiated by the HSC. This work involved the gathering of geologic and hydrologic data at the Hardage site to assess an in-place containment remedy later proposed by the HSC. As a result of this work, the HSC submitted the Final Confirmatory Bedrock Study in December of 1986 (HSC 1986). As a part of the EPA's public comment process for the ROD, the HSC's report also briefly presented the the HSC's proposed source control remedy. The HSC remedy called for in-place containment of the waste source areas by a cut-off wall supplemented by groundwater pumping. Differences between the HSC and EPA source control proposals were not resolved and resulted in litigation over implementation of the selected remedy. Work by the HSC in support of their proposed remedy continued at the site through November 1, 1988. Additional characterization of the source areas was conducted and reported in the HSC's Mound Characterization Field Study (HSC, 1988). From these and other studies performed as a part of the HSC's litigation efforts, the HSC prepared a Recommended Source Control Remedy design report (HSC, 1988) which provided additional technical details of the HSC's proposed remedy.

Meanwhile, in July 1985 the Court administratively closed the 1980 case against Hardage, providing that the U.S. could re-open the case for the purpose of seeking appropriate relief until April 1, 1986, at which time the case would otherwise be dismissed. The United States, on behalf of EPA, filed a motion on March 27, 1986, to amend the existing complaint and add newly discovered generators and transporters to the existing case. The Court ultimately denied the motion and dismissed the case. On June 25, 1986, the United States filed a new complaint naming 36 generators and transporters of waste at the site. The complaint asked for performance of the EPA selected source control remedy, maintenance of site security, conduct of a RI/FS for the management of migration (groundwater) operable unit, implementation of the groundwater operable unit remedy to be selected by EPA, and recovery of EPA's past and future response costs.

In 1987 the District Court issued a ruling indicating that the case would be decided in a "de-novo" trial, as opposed to a trial on the Administrative Record. The Court, in issuing that ruling, cited two factors peculiar to the case. First, the case was filed prior to the enactment of the Superfund Amendments and Reauthorization Act of 1986 (SARA), which called for Administrative Record review at trial. Second, the case was filed under RCRA as well as CERCLA; and RCRA does not mandate an Administrative Record trial.

After lengthy negotiations, a Partial Consent Decree between EPA and HSC was entered by the Court in February 1988. Under this Decree, HSC agreed to conduct a RI/FS addressing management of contaminant migration at the site under EPA oversight. The second operable unit RI/FS, and Endangement Assessment reports were submitted to EPA in the spring of 1989, finalized and sent to repositories in October of 1989.

Throughout 1988 both EPA and HSC took extensive depositions of both fact and expert witnesses. In early 1989, the Government initiated meetings with HSC to discuss ways of resolving on-going litigation.

On April 7, 1989 a Consent Decree was lodged with the U.S. District Court between EPA and approximately 170 "de minimis" (small quantity) PRPs for the site. Under this agreement, the de minimis parties resolved their liability for the site by making two cash payments: one to EPA to cover past cost incurred, and a second to a trust fund to be supervised by the District Court. The trust fund will be used for site remediation. This Consent Decree was entered by the court on September 22, 1989. The de minimi agreement was prepared in accordance with EPA's Interim Guidance on Settle -nt with De Minimis Waste Contributors under Section 122(g) of SARA (June 19, 1987) 52 Fed. Reg. 24333 (June 30, 1987).

## 2.3 Site Investigations

Studies of the Hardage site have been conducted since 1982. These studies, some of which were mentioned in Section 2.2, are part of EPA's administrative record for the site, and are described below:

March 1982

Ecology and Environment (E&E), an EPA contractor, sampled surface soils, drainage ways, and existing wells at the site. E&E also installed and sampled ten monitoring wells on and around the site. These wells are designated EW-1 through EW-10. This investigation is documented in a May 7, 1982 letter report from Imre Sekelyhidi of E&E.

August 1984

EPA contractor $CH_2M$ Hill and its subcontractors Chen Associates, Wright Water Associates, and Davenport-Hadley conducted a site investigation in 1984 to supplement the 1982 E&E data and allow selection by EPA of a source control remedy. This investigation involved installation and sampling of monitoring wells (the "GTW", "BW", "PW", and "AW" series of wells), limited coring of bedrock, sampling of the source areas, and sampling of shallow test pits. This investigation is documented in the the May 1985 report "Field Investigation and Data Summary Report" (DSR) prepared by $CH_2M$ Hill.

July - November 1985

HSC contractor ERM-Southwest conducted an investigation centering on conditions of the bedrock in the immediate vicinity of the source areas. This investigation included installation of monitoring wells and well nests MW-1 through MW-11, sampling of the shallow wells, resampling of some existing wells, and drilling vertical and slanted test borings B-1 through B-13 and SB-1 through SB-7. This investigation is documented in the December 1986 report "Confirmatory Bedrock Study" prepared by ERM-Southwest.

May 1987

E&E, on behalf of EPA, collected samples from all monitoring wells at the site. This work was monitored, and split samples collected by ERM-Southwest on behalf of HSC. HSC also recorded all work under the six week long project on videotape. The results of their sampling are documented in an August 31, 1987 letter repc t from E&E and in the Management of Migration RI.

October 1987 and March 1988

ERM-Southwest, c behalf of HSC, drilled fourteen cores MB-1 through MB-14 into the waste s.urce areas for chemical sampling and observation of physical conditions. Thi activity is documented in the HSC's "Mound Characterization Field Study" pre.ared by ERM-Southwest in November of 1988.

January - April 1988
ERM-Southwest, acting as litigation consultants on behalf of HSC, conducted a variety of activities on the site, including drilling of deep core holes (the "DH" holes), drilling of slant cores, photo-linear analysis, geophysical logging, reflection and cross-hole geophysics, radioisotope dating, and sampling of chloride for geochemical modeling. This activity is documented in the November 1988 report "Hydrogeologic Issues of Relevance to the Hardage Site" prepared by S.S. Papadopulos Associates.

April 1988 - October 1988
$CH_2M$ Hill and its subcontractor Chen Associates, acting on behalf of EPA, drilled eight bore holes into the source areas to retrieve samples for geotechnical and stabilization testing and to provide data on air emission of VOCs. Two test pits were also excavated to provide further data on air emmissions and on integrity of the buried steel drums. This activity is documented in the November 1988 report "Source Control Remedial Design" prepared by $CH_2M$ Hill.

July - October 1988
ERM-Southwest, on behalf of HSC and working under EPA oversight, conducted a comprehensive investigation of the extent of contamination and physical conditions at the site relative to migration of contaminants. This activity is documented in the May 1989 draft report "Second Operable Unit Remedial Investigation" (also refered to as the Management of Migration RI or Groundwater RI). ERM-Southwest also prepared and submitted to EPA a May 1989 draft "Second Operable Unit Feasibility Study Report" (or Groundwater FS). Both of these reports underwent revision based on EPA comment, were then approved by EPA and sent to repositories in October of 1989. HSC provided replacement pages to EPA during the public comment period which are addressed in the responsiveness summary in Appendix E.

## 2.4 Highlights of Community Participation

In preparation for this ROD amendment, EPA held a public comment period on the proposed comprehensive remedy. The comment period began October 13, 1989, and closed November 2, 1989. EPA provided notice of the public comment period through announcement in the newspaper on October 1, 1989, and at that time announced a public meeting on the proposed remedy. A fact sheet was prepared by EPA summarizing alternatives for both source control and groundwater and was sent to repositories and addressees on the site mailing list on October 12, 1989. EPA's Remedy Comparison Report and Remedy Report, along with the Administrative Record, were also sent to repositories on this date. A public meeting on the proposed remedy for the site was held on October 26, 1989, and approximately 40 people were in attendance.

EPA has addressed questions received during the public comment period, includi g those received at the public meeting, in the responsiveness summary (Appendix E).

## 3.0 SCOPE OF RESPONSE ACTION

The proposed remedy would address both the Source Control and Groundwater (Management of Migration) aspects of the Hardage site in a comprehensive remedial action. This proposed comprehensive remedy would remove a substantial portion of the liquid wastes, including many highly toxic and mobile volatile organic compounds, from source areas, thereby reducing the volume, toxicity, and mobility of the hazardous substances at the site. Moreover, this proposed comprehensive remedy would prevent further contamination of the alluvial aquifer.

To date the site has been investigated as two "operable units" - Source Control and Management of Migration or Groundwater. This approach was adopted in 1985 in an effort to speed remediation of the site. On November 14, 1986, EPA issued a ROD for the Source Control Operable Unit. This ROD selected a remedy, as previously discussed in Section 2.2, consisting of waste excavation and segregation followed by incineration of organic liquids and stabilization and consolidation of solids into a new landfill to be constructed on the site. Protracted litigation from 1986 through 1989 delayed implementation of the selected source control remedy.

In 1987 HSC agreed, pursuant to a partial Consent Decree with EPA, to conduct a RI/FS for the Groundwater Operable Unit of the site. Field studies were conducted in 1988 and a draft FS report was completed in May 1989 evaluating several remedial alternatives for groundwater at the site. It was proposed that any groundwater actions would be implemented in conjunction with a Source Control remedy.

Subsequent to the completion of EPA's Remedial Design Report, an issue arose concerning the potential impact of the RCRA land disposal restrictions on certain elements of the Source Control remedy selected in the 1986 ROD. The Agency's interpretation of the applicability of the land disposal restrictions to CERCLA response actions was then still evolving. Due to uncertainties over the ultimate resolution of this issue, EPA began to consider other alternatives for the Source Control remedy, which could unquestionably be implemented consistent with the RCRA requirements. Because of the timing of the draft Groundwater FS, and the concurrent evaluation of new Source Control technologies, EPA found it efficient and logical to combine Groundwater and Source Control alternatives in order to develop remedial alternatives that would address the entire site. As a result, a number of comprehensive remedial alternatives were assembled from source control and groundwater operable unit alternatives. Comprehensive alternatives are addressed in Section 6.4 and involve amendments to the 1986 ROD for source control and the selection of a remedial response actions for contaminated groundwater. One of those alternatives is presented as the selected comprehensive remedy for the site (see Section 7 for remedy selection criteria).

The proposed remedy would remove a substantial portion of the liquid wastes from the source areas. The Barrel Mound, and those portions of the Main Pit believed to contain drums, would be excavated. Containerized liquids, and free-phase liquids in the source areas, would be removed for offsite destruction. In addition, a relatively new technology, in-situ soil vapor extraction, would be implemented in the source areas to reduce those compounds most mobile in the environment. Soil vapor extraction would be effective in removing volatile and semi-volatile compounds, a number of which are carcinogenic, from the vadose zone, and from the surface of free-phase liquids in the source areas.

The proposed remedy would also prevent further contamination of the alluvial aquifer associated with North Criner Creek. Groundwater interceptor trenches (or possibly interceptor wells in the alluvial recovery area) would be installed to arrest migration of the plume of contamination from the site, and thereby allow the gradual process of restoration in the bedrock and alluvial systems to begin. Groundwater monitoring, institutional controls, and controls on the use of groundwater and surface water would be implemented to assure that humans are not exposed to contaminants.

## 4.0 SITE CHARACTERISTICS

### 4.1 Site Conditions

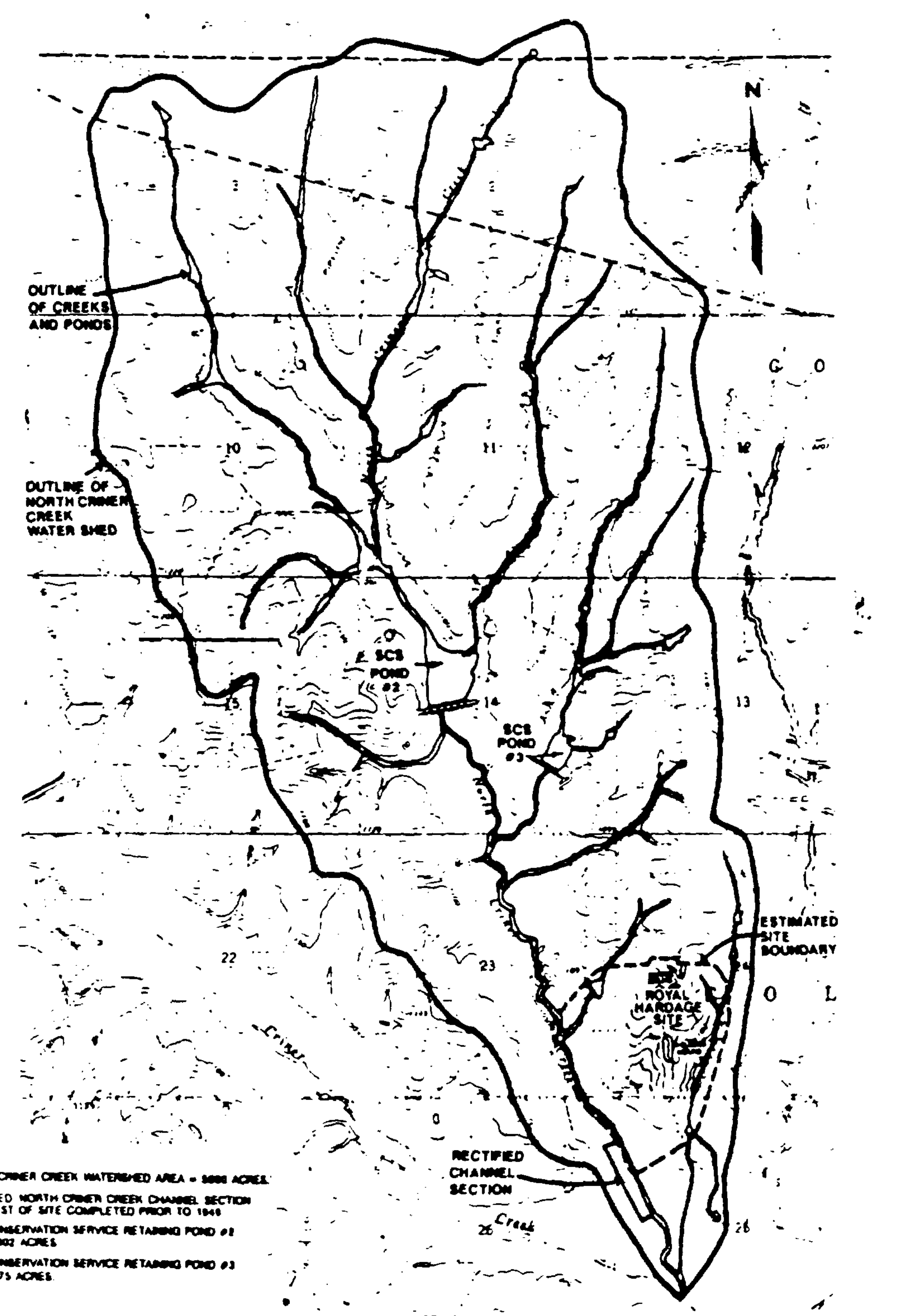
The Hardage site is situated on gently rolling property in a rural area of South Central Oklahoma. The principal disposal operations were conducted along a north-south trending ridge at the center of the property. Relief is about 100 feet from the ridge to the adjacent stream valley. The site is bounded on the southwest by the floodplain of a small perennial stream, and on the east by a series of three small ponds. Soil cover on the site is thin and subject to erosion. The underlying bedrock consists of a series of interbedded sandstones, siltstones, and mudstone. These rocks are fractured, as is well documented in various published studies including observation of cores, rock outcrops, and geophysical logs of borings.

The waste remaining onsite is primarily located in three source areas, the Main Pit, Barrel Mound and Sludge Mound. These three source areas will continue to release contaminants into the environment primarily via groundwater flow. At present, a groundwater plume of volatile organic contamination extends some 2800 feet southwest of the Main Pit with concentrations of volatile organic compounds exceeding 25,000 ppb. The plume ranges in width from about 1800 feet near the source areas to about 800 feet in the southwest corner of the site (see Section 4.2.3, Figure 4-6). Contaminants have migrated vertically and laterally from the source areas into the surrounding and underlying bedrock, both in dissolved form and as non-aqueous phase liquids (NAPL). The present and future migration of contaminants will continue via groundwater flow. Eventually, erosion may also carry wastes off the site from the three source areas and adjacent mixing areas.

#### 4.1.1 Surface Water Hydrology

The site is situated in the North Criner Creek drainage basin, approximately 0.8 miles from the confluence of North Criner Creek and Criner Creek (Figure 4-1). The drainage basin drains approximately 5,000 acres, and extends about four miles north of the site to the regional drainage divide between the Washita and Canadian rivers. The site, as stated above, is disected by a north-south trending ridge which controls runoff from the site (see Figure 4-2). Runoff from the western side of the site eventually enters a perennial stream, North Criner Creek, west and southwest of the site. Runoff from the east side of the site enters a series of three small ponds (the East Farm Ponds). These ponds drain southward through a fourth pond located on adjacent property before entering North Criner Creek south of the site. Drainage from the east side of the site is diverted from the east farm ponds by a berm and enters the stream below the southern most pond.

Drainage on the west side of the site from the source areas and much of the former operation area is channeled around an interceptor trench constructed by Royal Hardage to an impoundment known as the South Pond at the southwest corner of the site. The south pond is constructed such that an open discharge




NOTES

1 NORTH CRINER CREEK WATERSHED AREA = [illegible] ACRES.

2 RECTIFIED NORTH CRINER CREEK CHANNEL SECTION SOUTHWEST OF SITE COMPLETED PRIOR TO 1940

3 SOIL CONSERVATION SERVICE RETAINING POND #2 AREA = [illegible] ACRES

4 SOIL CONSERVATION SERVICE RETAINING POND #3 AREA = 575 ACRES.

SOURCE QUADRANGLE, COLE, OKLAHOMA N3500 W9730/7.5

SCALE

ERM-Southwest, Inc.
NEW ORLEANS, LOUISIANA HOUSTON, TEXAS

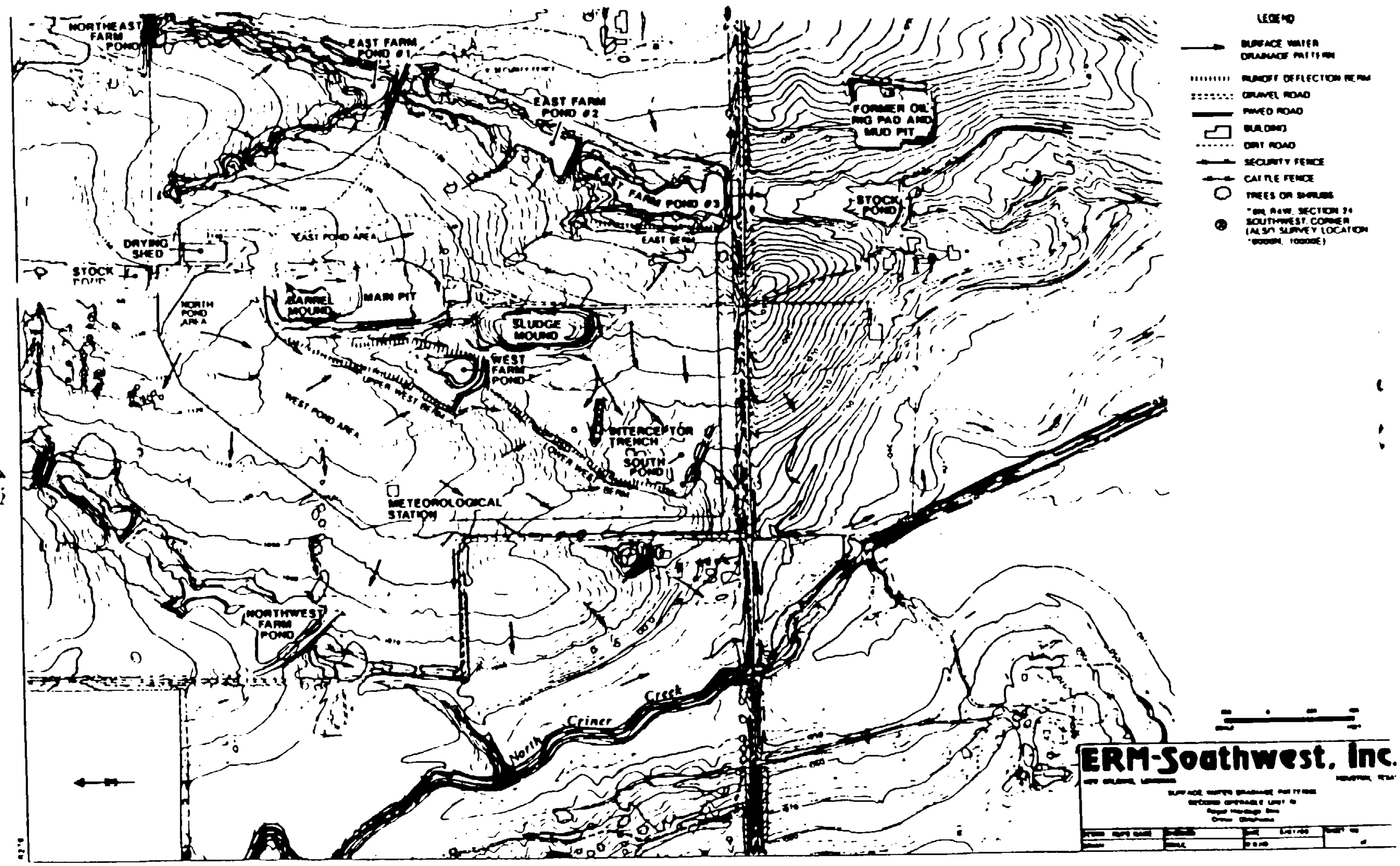
DATE 5/01/[illegible] W.O. NO. [illegible]

NORTH CRINER CREEK WATERSHED
Second Operable Unit RI
Royal Hardage Site
Criner, Oklahoma

FIGURE 4-1

FIGURE 4-2

SURFACE WATER HYDROLOGY




17

pipe near its base releases water to flow south into a roadside ditch. An unknown fraction of this water infiltrates downward from the pond. Runoff from the westernmost portion of the site is diverted around the south pond and enters the roadside ditch directly.

The southwest corner of the site abuts the North Criner Creek flood plain. North Criner Creek is a perennial stream with a nominal discharge of 0.8 to 1.3 cfs. The stream has been channelized directly south of the site.

The principal ponds, streams, and surface flow divides and paths are shown on Figure 4-2.

### 4.1.2 Site Geology

Bedrock beneath the site consists of a sequence of Permian aged sediments which grade from sandstone to siltstone, and mudstone. Despite the graditional nature of these deposits, extensive core samples have illustrated lateral continuity of four shallow bedrock zones refered to as Stratum I through IV. Bedding dips at outcrop locations near the site are less than one degree to the west and southwest.

Bedrock immediately beneath the Main Pit and Barrel Mound is comprised of a thin sequence of sandstone and siltstone (Stratum I). Approximately twenty feet beneath the Main Pit begins a sequence of mudstone/siltstone (Stratum II) approximately 20 feet thick. Beneath this is a sandstone/siltstone sequence (Stratum III) which is about 30 feet thick. Underlying Stratum III is a thick sequence of low permeability siltstone and mudstone, the upper 20 feet of which exhibits a predominance of siltstone. This bedrock sequence is illustrated in the generalized geologic cross-section shown in Figure 4-3. Bedrock over the entire site has been subject to natural weathering processes. As a result, the upper 20 to 40 feet of bedrock has been appreciably altered.

Fracturing has been observed in the bedrock layers, both in surface outcrops and in subsurface drill cores recovered from site investigations. Both low angle (less than 10 degrees from horizontal) and high angle (40 degrees on up to vertical) fractures have been reported. All three primary rock types (sandstones, siltstones, and mudstones) have had fractures reported. In addition, EPA believes that free-phase organic chemicals released from the source areas may have desiccated materials adjacent to fractures causing further opening of the fractures. The irregularity and heterogeneity of fracture distribution, interconnection and openness contribute to a relatively high degree of uncertainty regarding the large-scale hydraulic properties of the bedrock strata at the site, and therefore, high uncertainty regarding future waste migration rates and patterns.

Adjacent to the site, and associated with North Criner Creek, is an unconsolidated alluvial deposit with thicknesses up to [illegible] feet. Alluvial borings completed during the second operable unit RI typically encountered a thin silt/clay zone at a depth of 10-15 feet, which in turn was underlain by medium to coarse-grained silty sands. Bedrock underlying the alluvium was found to be a fine-grained silty mudstone, with some degree of weathering immediately beneath the alluvium.

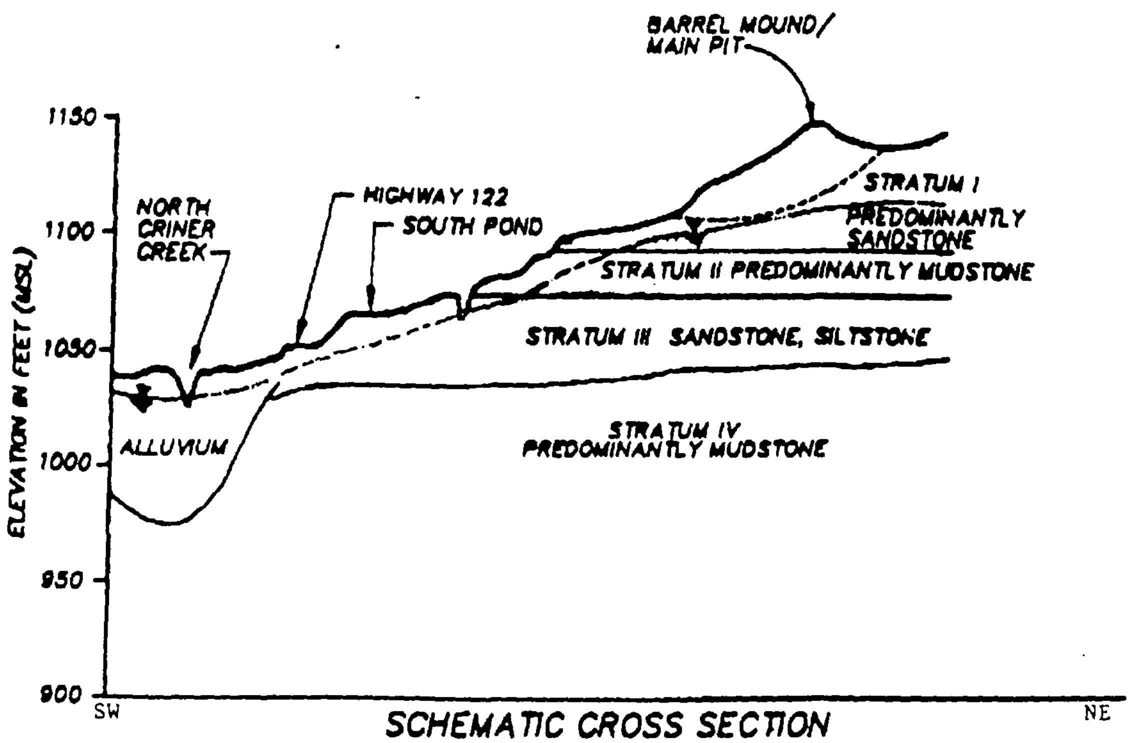



FIGURE 4-3

GEOLOGIC CROSS-SECTION
HARDAGE/CRINER SITE

4.1.3 Groundwater Hydrology

The geologic units described above, given their fractured and weathered conditions, have combined to form a hydrogeologic system as illustrated in Figure 4-4. This figure illustrates the hydrogeologic units at the site: (A) moderately permeable weathered shallow bedrock with general groundwater flow to the southwest into the alluvium of North Criner Creek (Stratum I-III and the top of Stratum IV, especially in the vicinity of the southwest alluvium); (B) a sequence of variably fractured siltstone and mudstone (the lower portions of Stratum IV); and (C) the North Criner Creek alluvium, a third hydrogeologic unit. The weathered zone and alluvial aquifer are the most permeable units at the site and, consequently, are the units most active in the local groundwater flow regime.

The water table across the site forms a continuous surface across Stratum I, II, and III, and is roughly parallel to the land surface as shown in Figure 4-4. The hydraulic conductivity reported for Stratum I through III ranges from about $2 \times 10^{-7}$ cm/sec to about $1.5 \times 10^{-3}$. Flow in these units has a large horizontal component with a gradient of about 0.01 to 0.07. Lower and higher hydraulic conductivities correspond to an estimated average flow velocity of 18 to 180 feet per year, consistent with the known distribution distances and patterns of contaminants in groundwater at the site. Stratum II has a somewhat lower hydraulic conductivity than Stratum I or III.

Groundwater flow in Stratum I-III in the vicinity of the east farm ponds varies seasonally and is affected by surface water levels in the ponds and recharge to soils. It is generally accepted that the ponds form a discharge boundary for groundwater flow. However, monitoring during and after any remedial action will be required to assure that contaminants are not migrating eastward, beneath the ponds.

Alluvial deposits of North Criner Creek can be separated into upper and lower portions that act as a single unit hydraulically. Nested monitoring wells in the alluvium indicate a general upward gradient through these deposits, implying upward flow out of Stratum IV into the alluvium. Pumping tests indicated an overall effective permeability on the order of $5 \times 10^{-3}$ cm/sec. Transmissivity values range greatly in the alluvium, however, the overall transmissivity is about 3200 to 3500 gpd/ft. Effective porosity ranges between 0.25 and 0.30.

Groundwater flow in the alluvium of North Criner Creek is generally toward the Creek, though skewed down-valley. Contaminants detected in the alluvial aquifer are also found in the source areas of the site. The concentration of total volatile organic compounds (which include toxic substances such as 1,2-dichloroethene and trichloroethene) are several hundred ppb in at least three alluvial aquifer wells. In general, North Criner Creek forms the discharge boundary to groundwater flow from the site, limiting migration of contaminants across the Creek.

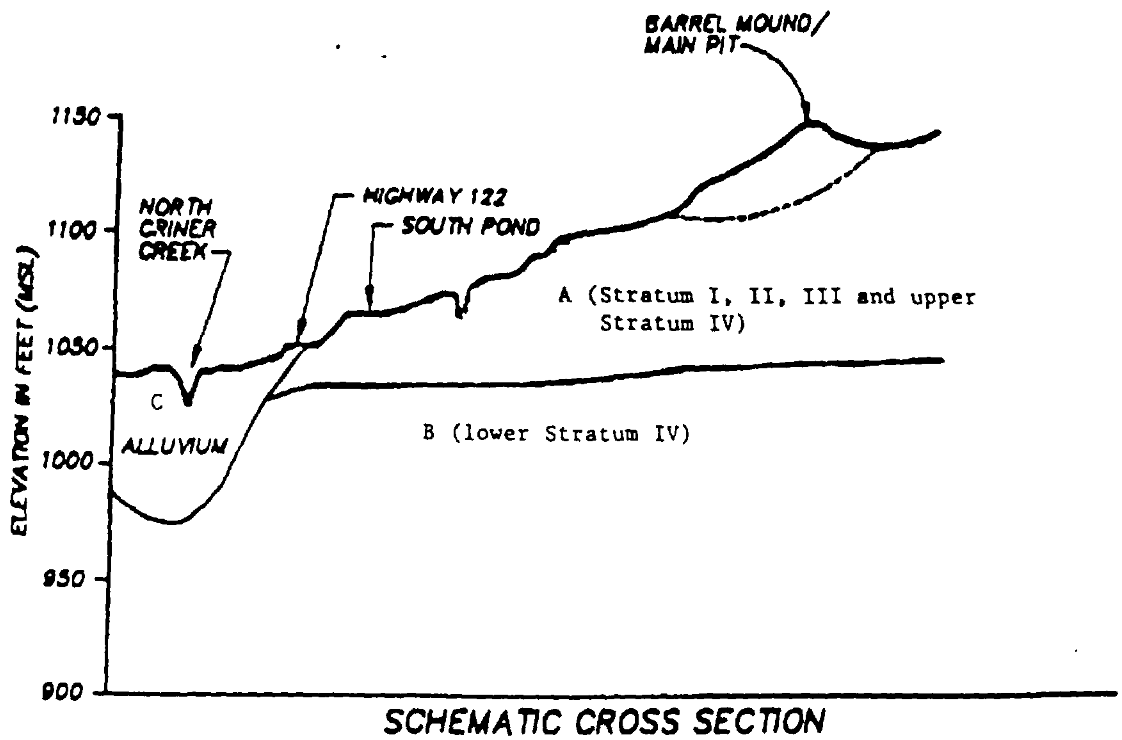



FIGURE 4-4

HYDROGEOLOGIC CROSS-SECTION
HARDAGE/CRINER SITE

## 4.2 Site Contamination

During the site operations, approximately 21 million gallons of industrial wastes including acidic, caustic and corrosive wastes, many classified as carcinogenic, were disposed on the Hardage site. During and after the operations, waste liquids migrated downward from several unlined impoundments, principally the Main Pit, North Pit, and West Pond (mixing) areas and to a lesser extent from the Sludge Mound, and East Pond (mixing) areas, and random spills on the site. Presently, approximately 70 acres of groundwater on and adjacent to the site is contaminated by organic compounds. Groundwater contaminant plumes have migrated east and southwest of the site. Contamination has entered the North Criner Creek alluvium, and has recently had a low but measurable impact on surface water quality (August 7, 1989 sampling). Surface and shallow subsurface soils at and around the source areas are contaminated by low levels of metals. Approximately 278,000 cubic yards of highly contaminated material exists in the Main Pit, Barrel Mound and Sludge Mound which contains soil, sludge, waste liquid, and intact drummed waste.

### 4.2.1 Impact of Disposal Operations

During operation of the site, several potential sources of groundwater contamination existed. These were:

- o Main pit/Barrel mound
- o Sludge Mound
- o North Pit
- o West Pond (mixing) areas
- o East Pond (mixing) areas
- o Miscellaneous spills, drum leaks, etc.
- o Contaminated runoff paths and south pond

Since liners were not constructed in any of these areas to limit waste seepage, and since the permeability of the soil profile and shallow bedrock is relatively uniform across the site, it is believed that those areas where waste liquids were impounded for the longest periods of time contributed most to groundwater contamination. The longer-term liquid storage and disposal areas were the Main Pit, Barrel Mound, Sludge Mound, West Pond, North Pit, and to some extent, the East Pond (see Figure 1-2). The remaining areas contributed lesser amounts of contaminants to groundwater contamination for reasons as follows:

- o Miscellaneous Spills - these were due to the nature of operations. Although drums were occasionally stored on site, the typical practice was to immediately discharge or dump wastes into the pits upon receipt. Therefore, spills probably did not release large volumes of waste liquids.

o Runoff - No information exists to indicate any impoundments were breached, or liquid waste was directly released except for limited seeps. Rainfall presumably contacted wastes, dissolving contaminants and carrying them down slope from the source areas. However, the contaminants in runoff would be highly dilute, as compared to that in waste pits. In addition, any infiltration of runoff would be transient, as compared to the continuous release from pooled waste liquids such as those in the main pit.

4.2.2 Remaining Contaminant Sources

In addition to contaminants which have dissolved into groundwater beneath and adjacent to the site, several potent "sources" exist which will tend to release further contamination from the site. These sources are:

a) Main Pit/Barrel Mound
b) Sludge Mound;
c) Residual soil contamination in the North pit and immediately west of the main pit; and
d) NAPL in bedrock beneath the source areas.

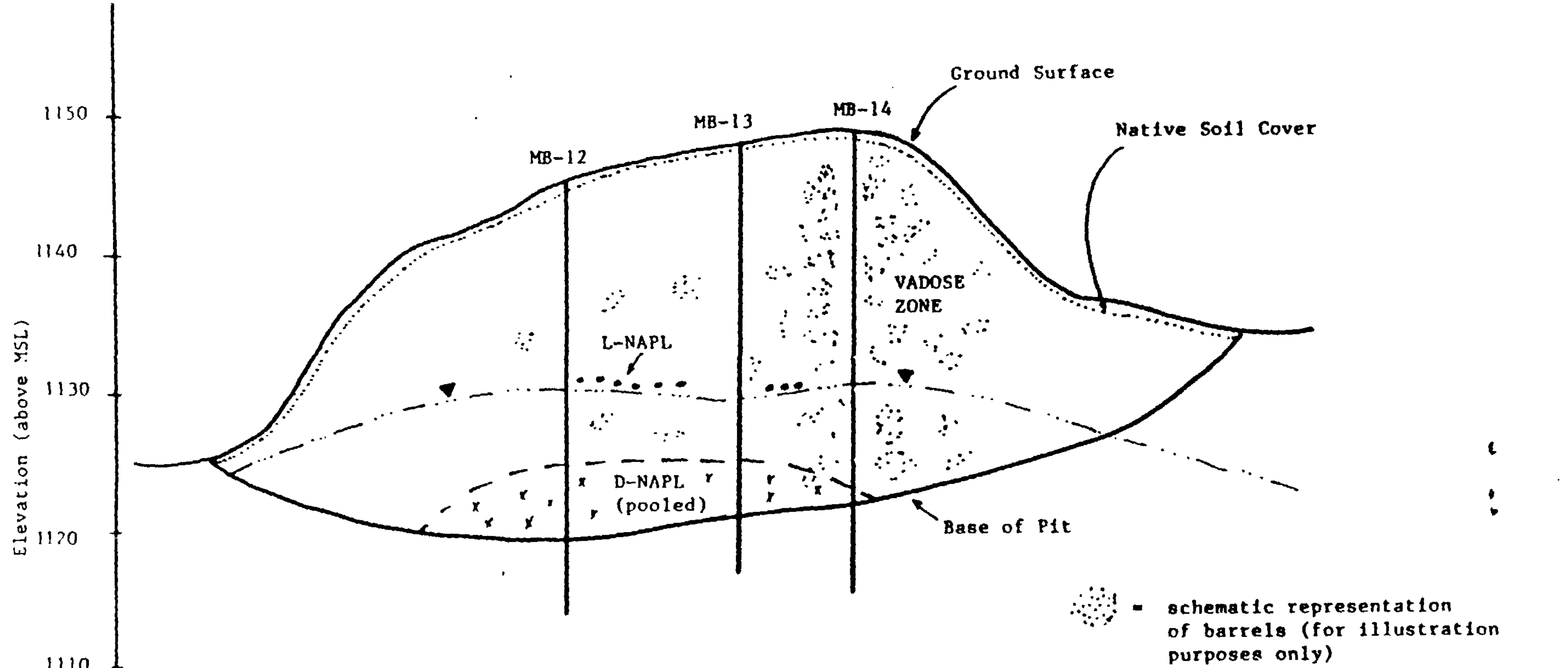
The content and character of these four sources is generally as follows:

a) Main Pit/Barrel Mound:
The Barrel Mound was built by random dumping of drums and the periodic spreading of soil to allow further drum dumping. As a result, the Barrel Mound is highly variable. Based on the history of disposal operations and data from three exploratory borings done in 1988, the mound consists of a two to three foot cover of native soils underlain by randomly oriented drums mixed with soils and waste sludges. At a depth of 5 to 10 feet, drilling yielded little data other than the depth to liquids, due to minimal core recovery. The liquids present at the base of the Barrel Mound appear to consist of a 6 inch layer of waste floating on water (L-NAPL or light non-aqueous phase liquids); 4 feet of water; and 4 feet of heavier than water wastes (D-NAPL or dense non-aqueous phase liquids) on the bedrock surface (see schematic illustration, Figure 4-5). The Barrel Mound would, due to the nature of its construction, be expected to have a large number of voids in and around drums. This expectation was supported by difficulties encountered in closing one boring (high grout take) and the inability to bail down waste liquid levels in two other borings. The other significant finding in the barrel mound borings was the apparent contamination of bedrock immediately underlying wastes.

At its southern end, the Barrel Mound grades into the Main Pit. The Main Pit is predominantly contaminated soil, however, concentrations of drums similar to those found in the Barrel Mound are present in about 1/3 of the main pit, particularly along the west bank. Localized pools of waste, similar to that in the Barrel Mound, are likely to be present in the Main Pit. While exploratory borings did not encounter such pooled liquids, areas of drum concentrations, those areas where pooled liquids would most likely be present, were intentionally avoided in drilling.

FIGURE 4-5

MAIN PIT AND BARREL MOUND CROSS-SECTION




Estimate of Liquids in Three Main Source Areas

| | | |
|---|---|---|
| Barrel Mound/Main Pit = (1.55 + 2.07 acres) | 113,500 | gallons (vadose zone) |
| | 660,000 | gallons (in drums) |
| | 956,000 | gallons (pooled liquids) |
| Sludge Mound = (1.72 acres) | 58,000 | gallons (vadose zone) |
| TOTAL | 1,800,000 | gallons |

Approximately 113,500 gallons of liquid are present in the soils of the the Main Pit/Barrel Bound (vadose zone) which together total 3.62 acres. An estimated 18,000 drums are buried in these areas representing some 660,000 gallons of stored liquids. (This assumes that two-thirds of the drums may be full).

b) Sludge Mound:
The Sludge Mound consists of layers of contaminated soil, oil recycling residues, and styrene tar wastes. Borings in the Sludge Mound indicated pockets of moist "stringy" sludge in addition to the overall soils contamination.

Approximately 58,000 gallons of liquid are present in the Sludge Mound (totalling 1.72 acres) weakly held in soil pores under capillary forces.

c) Residual Soil Contamination:
The former North Pit is underlain by a number of pockets of contaminated soils and 50 to 80 drums buried in shallow trenches. Sediment in the drainage channel along the west side of the Main Pit has been heavily contaminated by waste seepage from the Main Pit to a depth of five to ten feet. Contaminated soils are also present in the west pond area.

d) NAPL in Bedrock:
Pure free-phase (NAPL) has been observed at three locations adjacent to the source areas (B-13, MW-6, and MW-2). These wastes are present both at the water table and in the deeper more competent sandstone (Stratum III). The NAPL tends to be several thousand times as contaminated as the surrounding groundwater. However, similar to an oil layer floating on water, the separate phase waste cannot fully dissolve into the water. In the subsurface, clean groundwater tends to pick up dissolved contaminants as it flows around and through the NAPL. In this manner, the NAPL acts as a potent source of continuing contamination within the normal groundwater flow regime. Pockets at and beneath the water table are in a position to readily contaminate the surrounding groundwater.

Liquid accumulations have created a pool of liquids at the bottom of the main source areas estimated to be 956,000 gallons (see Figure 4-5).

The Main Pit, Barrel Mound and Sludge Mound are the largest sources of potential further site contamination. Exploratory borings have indicated that these areas consist of 278,000 cubic yards of wastes. Chemical sampling has indicated that some 171,500 gallons (113,500 + 58,000) of volatile chemicals are suspended in the soil vadose zone. Pooled liquids and intact drums are estimated to total 1,616,000 gallons (660,000 + 956,000), although precise quantification of the volume is not possible.

Table 4-1 lists a number of EPA classified carcinogens detected in the source area characterization holes.

Table 4-1
CARCINOGENS[1] DETECTED IN THE SOURCE AREAS CHARACTERIZATION HOLES[2]

| Compound | Class |
|---|---|
| 2,4,6-trichlorophenol | B2 |
| bis(2-chloroethyl)ether | B2 |
| 1,4-dichlorobenzene | B2 |
| 2,6-dinitrotoluene | B2 |
| 1,2-diphenylhydrazine | B2 |
| isophorone | C |
| N-nitrosodiphenylamine | B2 |
| bis(2-ethylhexyl)phthalate | B2 |
| butyl benzyl phthalate | C |
| beno (a) anthracene | B2 |
| benzene | A |
| 1,2-dichloroethane | B2 |
| 1,1,2,2-tetrachloroethane | C |
| chloroform | B2 |
| 1,1-dichloroethene | C |
| methylene chloride | B2 |
| tetrachloroethene | B2 |
| trichloroethene | B2 |
| PCB-1260 | B2 |
| toxaphene | B2 |
| vinyl chloride | A |
| 1,1,2-trichloroethane | C |

[1] EPA classified carcinogens
Reference: USEPA, Health Effects Assessments Summary Tables, Second Quarter, 1989.

[2] Source USEPA (1985)

4.2.3 Pathways and Extent of Contamination

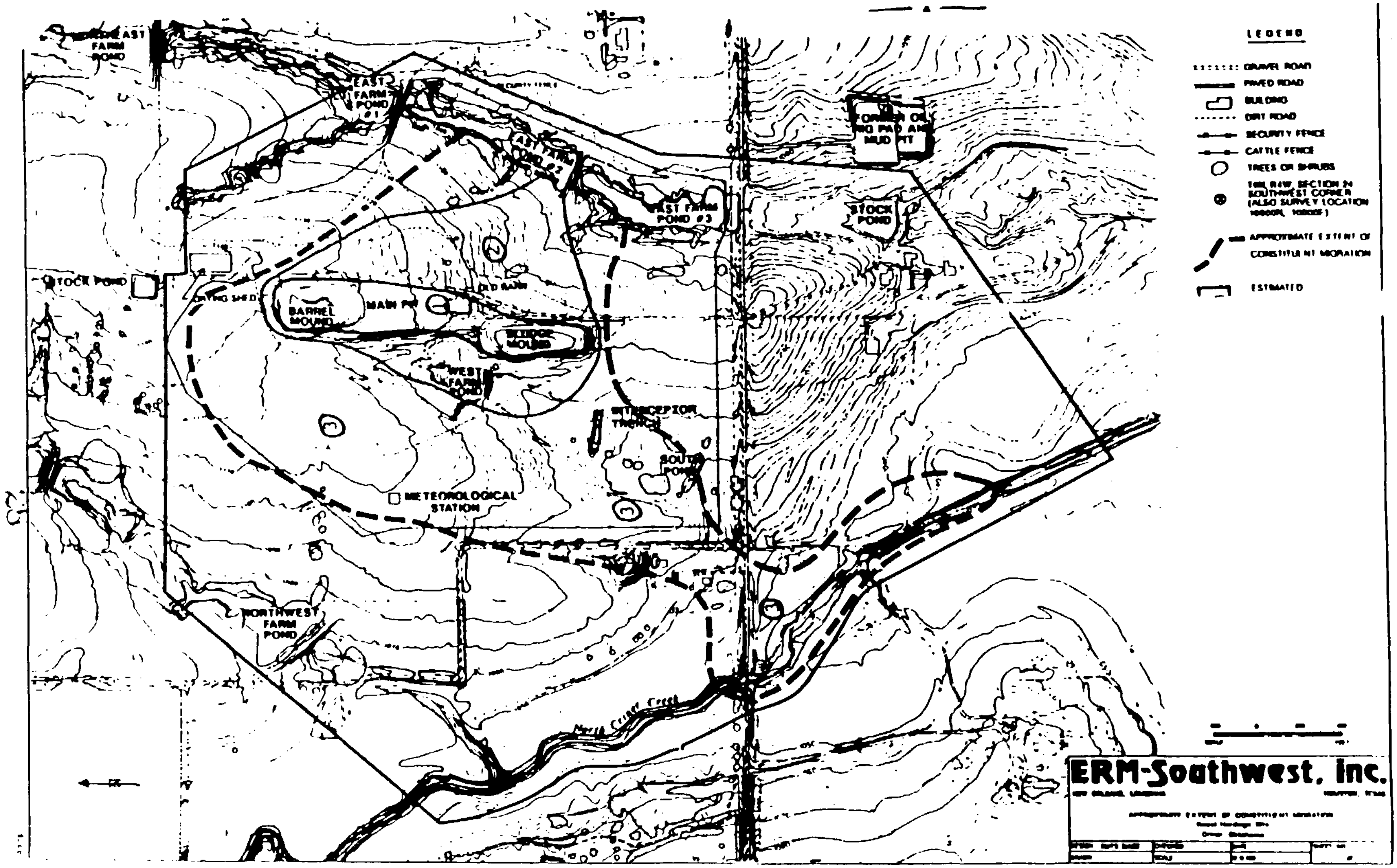
Contaminants have been transported on and away from the site by groundwater flow. Additional contaminants have also migrated from the source areas by way of surface water runoff; however, sampling data from wells in the alluvial aquifer indicate that groundwater flow, rather than surface water runoff, has been the predominant pathway for migration. Groundwater containing dissolved contaminants migrates vertically and southwestward toward the North Criner Creek alluvium and then upward into the alluvium and into the Creek.

Upward migration of groundwater from Stratum IV into the alluvium of North Criner Creek is documented by upward gradients in water levels of wells constructed at different depths in the alluvium. If contaminants are entering the alluvium primarily from the underlying bedrock (Stratum IV) and moving upward, contaminant concentrations should be higher in the lower part of the alluvial aquifer than in the upper portion. Conversely, if the contaminants are entering the alluvial aquifer primarily by percolating downward from the surface runoff water, the concentrations in the upper groundwater should be higher than in the lower groundwater. Sample analyses data from two different depths in the aquifer (wells MW-12S, -12M and MW-13S, -13M) show that the volatile organic chemical concentrations are greatest in the lowest portion of the aquifer, indicating that the contaminants have probably migrated through the bedrock from the site and into the lower alluvium (as opposed to the surface water pathway) (Reference, Affidavit of John B. Robertson).

During site operations, volatilization of chemicals into ambient air resulted in the release and transport chemicals offsite. This pathway was reduced with closure of the pits and capping of wastes. No residual effects have been identified, and none are believed to exist from air pathway transport due to the volatile organic nature of contaminants. At the present time and in the near future, transport of contaminated groundwater and discharge to surface waters are the only pathways of consequence. If the site is not properly remediated, contaminants will also eventually be released from the site in substantial quantities by erosion and runoff and to a lesser extent through slow volatilization to the atmosphere. As contaminants are exposed there would be an additional pathway for risk through direct contact with contaminated materials. The above pathways are discussed in further detail below.

Groundwater:

The principal pathway of contaminant migration at the Hardage site is through dissolved phase groundwater flow. Groundwater contamination emanating from the source areas extends approximately 600 to 800 feet to the east farm ponds. The contamination plume extends offsite to North Criner Creek, approximately 1600 feet. The plume in the alluvial aquifer is distorted, both parallel to and towards North Criner Creek. Overall, the groundwater plume underlies approximately 70 acres on and adjacent to the site (Figure 4-6, Area 3).




① Predominantly NAPL Plume

② Semi-volatile Plume

③ Volatile Plume

FIGURE 4-6
APPROXIMATE EXTENT OF
GROUNDWATER CONTAMINATION

The groundwater contaminant plume contains a wide variety of volatile organic chemicals which include toxic compounds such as 1,2-dichloroethene and trichloroethene. A summary of contaminants and their concentration for onsite wells is presented in Table 4-2. Beneath and immediately adjacent to the source areas (Figure 4-6, Area 1) volatile, semivolatile, and pesticide compounds are present at their highest levels, in some cases exceeding 25,000 ppb for volatile organics. At three locations NAPL has been encountered (MW-6, B-13, and MW-2). Additional pockets of NAPL are almost certainly present in other areas beneath the source areas, particularly at the Barrel Mound. A somewhat larger portion of the plume (Figure 4-6, Area 2) contains both volatile and semivolatile contaminants, but not NAPL. This, the "semi-volatile plume", extends over 600 feet eastward to where the plume discharges into the east farm ponds. To the southwest, the semi-volatile plume extends only about 200 feet (to well MW-45). Contamination by volatile organic chemicals (VOC) is most widespread and defines the extent of contamination. The VOC plume extends southeast into the alluvium of North Criner Creek (see Figures 4-6, Area 3). Contaminated groundwater flowing southwest through the onsite bedrock discharges to the alluvial aquifer. This discharge constitutes the source of continuing contamination in the alluvium (see Figures 4-4 and 4-7,. Average flow rates along this pathway have been estimated at 110 feet per year (Affidavit of John B. Robertson).

Discharge of Contaminated Groundwater to Surface Water:

Both the east farm ponds and North Criner Creek receive contaminants via discharge of groundwater to the surface waters. The contaminants entering North Criner Creek are chlorinated ethanes and chlorinated ethenes. Since these chemicals are volatile, natural processes rapidly strip volatiles from the surface waters, and release them to the air. Sampling of North Criner Creek has only most recently detected contamination (1-2 dichloroethene, 5 ppb and trichloroethene approximately 2 ppb), and supports the belief that the discharge of contaminated groundwater can have a measureable impact on surface water quality in the Creek.

Volatile chemicals also enter the east farm ponds. Sampling to date has not indicated the presence of volatiles; however, more persistent semivolatile chemicals are seeping into the southernmost east farm ponds and are impacting water quality in the immediate vicinity of the seeps. These compounds appear to be entering the farm pond due to seepage of NAPL along the bedrock surface. Dilution of this seepage is presently occuring so that impacts on water quality of the pond have not been measureable.

TABLE 4-2

## Comparison of the Groundwater Data from the Alluvial Wells Adjacent to the Hardage/Criner Site with Maximum Contaminant Levels Set by the Safe Drinking Water Act

| Contaminant | MCL ug/l | Greatest Concentration ug/l | Total Detections | Total Detections >MCL | Greatest "Quantitative" Concentration ug/l | Total "Quantitative" Detections | Total "Quantitative" Detections >MCL |
|---|---|---|---|---|---|---|---|
| Trihalomethanes | 100 | 8.7 | 7 | 0 | 8.7 | 7 | 0 |
| 1,2-Dichloroethane | 5 | 240 | 13 | 8 | 240 | 13 | 8 |
| 1,1,1-Trichloroethane | 200 | 120 | 26 | 0 | 120 | 26 | 0 |
| Vinyl chloride | 2 | 4.5 | 4 | 2 | 4.5 | 4 | 2 |
| 1,1-Dichloroethene | 7 | 57 | 27 | 20 | 57 | 27 | 20 |
| trans-1,2-Dichloroethene | 70 | 370 | 25 | 13 | 370 | 25 | 13 |
| Trichloroethene | 5 | 290 | 29 | 28 | 290 | 29 | 28 |
| Tetrachloroethene | 5 | 29 | 17 | 11 | 29 | 17 | 11 |
| Benzene | 5 | 1 | 1 | 0 | 1 | 1 | 0 |
| PCBs | 5 | 4.4 | 1 | 0 | 4.4 | 1 | 0 |
| Arsenic | 50 | 19 | 19 | 0 | 12 | 18 | 0 |
| Barium | 1000 | 990 | 52 | 0 | 606 | 41 | 0 |
| Cadmium | 10 | 11 | 4 | 1 | 9 | 1 | 0 |
| Chromium | 50 | 129 | 6 | 2 | 37 | 2 | 0 |
| Fluoride | 4000 | 380 | 21 | 0 | 380 | 21 | 0 |
| Lead | 50 | 28 | 7 | 0 | 28 | 4 | 0 |
| Mercury | 2 | 0.6 | 2 | 0 | 0.6 | 2 | 0 |
| Nitrate | 10000 | 6100 | 20 | 0 | 6100 | 20 | 0 |
| Selenium | 10 | 76 | 14 | 4 | 76 | 12 | 4 |
| Silver | 50 | 6 | 2 | 0 | 6 | 2 | 0 |

References:


*K. W. Brown & Associates, Inc. August 9, 1989. Groundwater Contamination at the Hardage Site: Organic Data Tabulated by Well.*

*K. W. Brown & Associates, Inc. August 9, 1989. Groundwater Contamination at the Hardage Site: Inorganic Data Tabulated by Well.*

TABLE 4-2 (continued)

## A Comparison of the Groundwater Data at the Hardage/Criner Site with Maximum Contaminant Levels Set by the Safe Drinking Water Act

| Contaminant | MCL ug/l | Greatest Concentration ug/l | Total Detections | Total Detections >MCL | Greatest "Quantitative" Concentration ug/l | Total "Quantitative" Detections | Total "Quantitative" Detections >MCL |
|---|---|---|---|---|---|---|---|
| Trihalomethanes | 100 | 154900 | 74 | 18 | 154900 | 60 | 15 |
| Carbon tetrachloride | 5 | 4 | 1 | 0 | 0 | 0 | 0 |
| 1,2-Dichloroethane | 5 | 350000 | 89 | 76 | 350000 | 76 | 65 |
| 1,1,1-Trichloroethane | 200 | 32000 | 110 | 26 | 32000 | 85 | 23 |
| Vinyl chloride | 2 | 10000 | 37 | 31 | 10000 | 33 | 27 |
| 1,1-Dichloroethene | 7 | 8200 | 119 | 95 | 8200 | 97 | 78 |
| trans-1,2-Dichloroethene | 70 | 9500 | 114 | 64 | 9500 | 91 | 52 |
| Trichloroethene | 5 | 11000 | 125 | 107 | 11000 | 100 | 82 |
| Tetrachloroethene | 5 | 28000 | 92 | 68 | 28000 | 74 | 55 |
| Benzene | 5 | 420 | 24 | 9 | 420 | 21 | 7 |
| 1,2-Dichlorobenzene | 75 | 2500 | 20 | 5 | 2500 | 16 | 2 |
| PCBs | 5 | 1000 | 7 | 6 | 1000 | 6 | 6 |
| Arsenic | 50 | 28 | 56 | 0 | 28 | 52 | 0 |
| Barium | 1000 | 3300 | 204 | 202 | 712 | 138 | 0 |
| Cadmium | 10 | 75 | 20 | 9 | 75 | 14 | 7 |
| Chromium | 50 | 1180 | 52 | 17 | 1180 | 26 | 8 |
| Fluoride | 4000 | 11000 | 76 | 1 | 11000 | 76 | 1 |
| Lead | 50 | 94 | 22 | 1 | 94 | 9 | 1 |
| Mercury | 2 | 1.1 | 12 | 0 | 0.7 | 9 | 0 |
| Nitrate | 10000 | 7000 | 71 | 0 | 7000 | 71 | 0 |
| Selenium | 10 | 76 | 53 | 13 | 76 | 34 | 8 |
| Silver | 50 | 17 | 10 | 0 | 17 | 9 | 0 |

References:


*K. W. Brown & Associates, Inc. August 9, 1989. Groundwater Contamination at the Hardage Site: Organic Data Tabulated by Well.*

*K. W. Brown & Associates, Inc. August 9, 1989. Groundwater Contamination at the Hardage Site: Inorganic Data Tabulated by Well.*

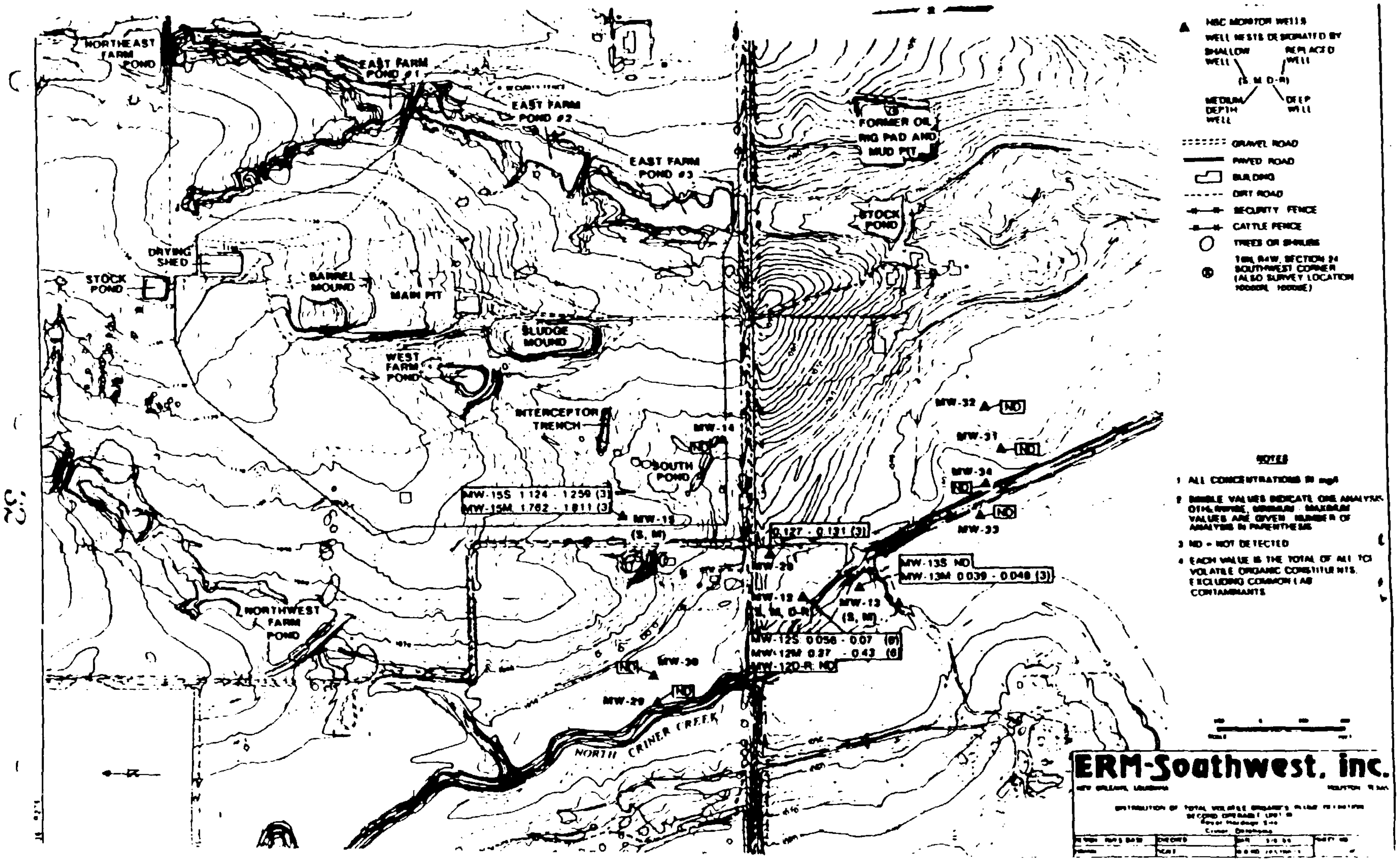



FIGURE 4-7

DISTRIBUTION OF TOTAL VOLATILE ORGANICS
IN STRATUM III AND THE ALLUVIUM

Surface Water Runoff and Sediment Transport:

Surface water runoff and sediment transport will constitute substantial pathways for contaminant transport from the site over the long-term if the site is left unremediated. Vegetation over much of the site, including the source areas, is sparse due to the removal of the topsoil in the course of site operations. The lack of vegetation contributes to soil erosion. In addition, the final contour of the waste mounds is not conducive to long-term stability. Leachate seeps from the western side of the waste mounds are common in the wet, spring months. Rainfall runoff tends to spread this leachate downslope, resulting in visible contamination as far southwest as the existing interceptor trench.

4.2.4 Future Contaminant Migration

Left unremediated, contaminants will continue to migrate off of the site and spread on the site by the following general pathways:

1. expansion of the plumes of contaminated groundwater;
2. leakage and spread of waste liquids from the Barrel Mound and Main Pit, which will in turn continue to feed the plumes on contaminated groundwater;
3. dissolution of contaminants by groundwater infiltrating through the the Sludge Mound, Main Pit, Barrel Mound, and areas of residual contamination; and
4. transport of wastes and contaminated soils from the Main Pit, Barrel Mound, Sludge Mound and adjacent mixing areas via erosion and runoff.
5. long-term low-level releases of volatile compounds to the atmosphere

The groundwater contaminant plumes present at the Hardage site have developed over the 17 years since operations started at the Hardage site. Left unremediated, plumes of contamination in the vicinity of both the east farm ponds and North Criner Creek will expand. Modelling of the southwest alluvial plume in the Remedy Report (EPA, 1989) predicted a gradual expansion approaching 2000' (with dilution) even with the source of contamination to the alluvium cut off. Without source control and groundwater remedial actions, the southwest alluvial contaminant plume would certainly continue to expand southeastward, parallel to the stream. The plume near the east farm ponds may expand eastward beneath the ponds, although this is uncertain due to remaining questions about groundwater and surface water interaction acting as a barrier to migration around the ponds.

Waste liquids in the Barrel Mound and Main Pit will continue to migrate into the surrounding bedrock and groundwater in accordance with the conceptual model illustrated in Figure 4-5. Liquids in the Barrel Mound are released as drums of waste liquid corrode and as liquids drain from saturated soils (under gravity and consolidation). These liquids drain downward through the permeable mounds and accumulate on the less permeable sandstone and siltstone bedrock surface at the base of the pit. This pool of waste liquids tends to drain downward under gravity through pores and fractures in the shallow bedrock. As the liquids move downward some 10-15 feet below the base of these pits, they encounter a less permeable bedrock horizon and tend to spread out across the upper surface of that horizon and migrate with a lateral component, as seen at locations MW-2 and MW-6.

In their present condition, the source areas are susceptible to infiltration of rainfall. As this water percolates downward through the source materials, it dissolves contaminants and carries them downward to the groundwater system. This is a potential continuing source of release on the site.

Over time, erosion of contaminated soils is expected to increase to a point where substantial offsite releases occur via erosion and runoff.

## 5.0 SITE RISKS

The Hardage site received hazardous wastes that are either known or suspected carcinogens such as vinyl chloride and benzene. Table 4-1 gives a more complete list of carcinogens found at the site. Other compounds either are or are believed to be acutely toxic or capable of causing damage to specific organs. Some of these compounds also bio-accumulate in plant, animal, and human tissues. The Hardage Site was permitted to receive all types of industrial and hazardous wastes except radioactive wastes. Table 2-1 lists some of the wastes known to have been received at the site.

There are four primary ways humans can be exposed to the hazardous wastes at the Hardage site. The first and most important of these is exposure to contaminated groundwater. The groundwater at the Hardage site is contaminated with waste migrating from the source areas into the bedrock and alluvial groundwater systems. Not only is the groundwater under the site contaminated with these hazardous wastes, but the contamination has spread beyond the site to the south and has already forced local residents to stop using their water wells.

The contaminated water wells are located in the North Criner Creek Alluvium which lies below the Creek south of the site. This aquifer is contaminated with the chemicals exceeding the standards for consumption of drinking water as set under the Safe Drinking Water Act that are also given under the column titled MCL in Table 4-2.

As Table 4-2 shows, eight of these contaminants are already above the limits. The nearest of the contaminated residential wells is the old Corley well. The old Corley well is located approximately 500 feet southwest of the site. Estimates of the risk of cancer from lifetime use of residential water contaminated at the level of the old Corley well range from 0.0007 (seven per ten thousand) to 0.006 (six per thousand) far above the one in one million level commonly used as an acceptable risk. These estimates were arrived at using average concentrations of contaminants in the old Corley well and making assumptions about standard ingestion of water, inhalation exposures and dermal exposures from household use.

With the North Criner Creek alluvium already contaminated, one of the goals of the cleanup will be to restore the groundwater to a useable condition. The standards used to judge the effectiveness of the cleanup alternatives for groundwater will be the Maximum Contaminant Levels set under the Safe Drinking Water Act (MCLs). The effect of the proposed cleanup plans can be compared through their effects on the concentration of contaminants in the North Criner Creek alluvium. The proposed EPA remedies would result in lower concentrations of contaminants in groundwater in the alluvium of North Criner Creek through removal and destruction of contaminants at the source and interception and treatment of groundwater by trenches. While it is not possible to accurately assess how long the source areas would continue to bleed contaminants into the groundwater systems, it does not require and expert to conclude that if the HSC remedy leaves 10 or 100 times more of the most problematic waste liquids in the site than EPA's remedy, then the long-term duration of the EPA remedy would be shorter. The EPA remedy would therefore attain MCLs more quickly than the HSC remedy.

Direct contact with wastes on the surface of the site also poses hazards; however, the health risk is highly variable depending upon area of exposed waste and level of human traffic and has not been quantified. Human traffic on the site is minimal; but cattle did occasionally graze on the site. Contamination of the food-chain (for example beef and milk from cattle eating contaminated grass) by lead, chromium, pesticides, and PCBs on the surface of the site poses long-term hazards. This concern prompted construction of a fence to keep cattle and people off of the source areas. Certain compounds such as pesticides and PCBs have the ability to bioconcentrate through successively higher levels of the food chain (EPA, 1985a).

Inhalation of volatiles and concentrated airborne particulates on and possibly adjacent to the site may also pose long-term hazards if the site remains unremediated, but again this risk is highly variable depending upon the quantity of exposed contamination.

## 6.0 DESCRIPTION OF ALTERNATIVES

A large number of remedial alternatives have been formulated to address part or all of the Hardage site. As discussed in Section 3, the site has been considered as two "operable units". Source Control measures were considered by EPA in a 1986 FS. In November 1986, EPA issued a ROD which selected a Source Control remedy with incineration of liquid wastes and stabilization and containment of solids in a new landfill to be built on-site. HSC objected to the selection of this Source Control remedy and proposed an alternate Source Control remedy in December 1986 which called for in-place containment of the waste source areas by a cut-off wall and groundwater pumping. HSC declined to implement the EPA selected remedy which resulted in litigation in 1986. EPA maintained that the remedy selected in the 1986 ROD was technically sound and completed the Source Control Remedial Design in 1988. In 1987, HSC signed a partial Consent Degree with EPA for the conduct of an RI/FS for groundwater (Management of Migration). In May 1989 HSC, pursuant to the Consent Decree, submitted a draft FS on Management of Migration to EPA for review and approval.

During conduct and preparation of the groundwater RI/FS, uncertainty arose over the impact of RCRA Land Disposal Restrictions on the EPA selected Source Control remedy. To alleviate this uncertainty, EPA undertook consideration of an alternative Source Control remedy based upon the new technology of in-situ soil vapor extraction. Evaluation of soil vapor extraction in conjunction with alternative presented in the groundwater FS resulted in consideration of alternatives addressing the entire site in contrast to the original Operable Unit approach. On June 30, 1989, the United States advised the District Court of EPA's decision to consider a comprehensive site remedy.

On July 6th and in greater detail on October 13, 1989 the defendants presented to the court their plan to further define an additional remedial alternative. This, the HSC alternative, was similar to EPA's alternative except that the HSC plan did not include soil vapor extraction, enhanced recovery of containerized liquids, or the shallow waste liquid recovery trench proposed by EPA.

Previous and new alternatives for the control of the contaminant sources are summarized below in Section 6.1. Alternatives for groundwater as contained in the groundwater FS are summarized in Section 6.2. Common monitoring and support components for Groundwater and Source Control alternatives are listed in Section 6.3. Finally, Source Control and Groundwater alternatives are combined and summarized in Section 6.4.

## 6.1 Alternative Source Control Components

A number of alternatives were considered for remediation of the Source Control areas prior to the 1986 ROD. These can be seen in more detail in the 1986 ROD in Appendix F, along with evaluation criteria for remedy selection. Those remedies which were considered fell into four basic categories: no action; disposal onsite in a landfill (the EPA selected remedy in the 1986 ROD); containment of wastes in place (the HSC counter proposal of a cut-off wall); and incineration (also considered in the 1986 ROD). The following four sections summarize each of these categories.

6.1.1 No action. As the title implies, no work would be done to mitigate hazards from the site. The alternate water supply, security fence, and site stability measures would not be maintained.

6.1.2 Onsite Landfill (EPA 1986 ROD Remedy). The source areas would be excavated and separated for treatment. Organic liquids would be bulked and shipped offsite for thermal treatment at a permitted facility. Inorganic liquids would be treated and discharged to an onsite impoundment for evaporation. Solids would be stabilized by blending with 8-10% cement kiln dust and placed in a new double lined landfill cell constructed on-site in accordance with the Minimum Technology Requirements (MTR) of RCRA. The 1986 estimate of most probable cost was 70 million dollars.

6.1.3 Containment of wastes, Cap and Cut-off wall (HSC Proposal). A plastic cement "cut-off" wall would be constructed in panels so as to encircle the source areas. This wall would range from 70 to 130 feet in depth and, at its base, key 10 to 20 feet into the low permeability siltstone and mudstone of Stratum IV. Wells would be drilled through the Source areas and completed in the bedrock within the periphery of the wall. The water and wastes would be pumped from these recovery wells in an effort to induce a hydraulic gradient inward through the wall and prevent the outward migration of contaminants. Pumping would be conducted indefinitely.

Vertical waste liquid extraction wells would be drilled into the Barrel Mound and pumped in an effort to remove pooled liquid for treatment. In addition, lateral drains would be drilled from the west into the base of the Barrel Mound. These drains would slope slightly downward out of the mound to allow free drainage of waste liquids and groundwater from the Barrel Mound over time.

An effort would be made to speed consolidation of the Barrel Mound by placing a 20 foot thick soil layer as a surcharge for a period of 6 months to a year. After removal of the surcharge, a MTR cap would be installed over the source areas. The most probable cost estimate was 25 million dollars.

6.1.4 Incineration (EPA Proposal in 1986 ROD). The source areas would be excavated. Wastes would be incinerated in a kiln constructed onsite or at a commercial incinerator offsite. The ash would still contain metals and until it could be proven otherwise through de-listing, would require disposal as a hazardous waste. Estimates in 1986 for cost of incineration ranged from 133 to 374 million dollars.

The no action alternative was eliminated from consideration early as not being protective of human health or the environment due to continued vertical and lateral migration source area wastes offsite. Containment of the contamination in place was eliminated due concerns over continued migration of the contamination, doubts that containment techniques such as slurry walls could be installed effectively, and concerns relating to merely containing the sources of contamination rather than actively remediating them to achieve a permanent reduction in their volume, toxicity, or mobility.

The alternatives that remained were onsite disposal and incineration. The onsite landfill alternative was eventually selected as providing a degree of protection to human health and the environment similar to that which could be achieved with complete incineration, but which could be carried out in a shorter time and at a reduced cost. A more detailed comparison is given in the 1986 ROD in Appendix F. With this background, onsite disposal was selected in the 1986 ROD.

The new alternative for Source Control in the October 1989 Proposed Plan contained components for a new approach to Source Control. These components are as follows:

6.1.5 Liquid Extraction Wells

A system of vertical extraction wells would be installed throughout the three main source areas. The wells would be used for extracting free liquids that are found in the source areas, and liquids that would be released from the drums as a result of the lancing procedure described below, should it be used. The wells could also be used as part of the soil vapor extraction process described below.

An estimated approximately 956,000 gallons of aqueous and nonaqueous liquids presently reside in the saturated portions of the source areas. The quantity of residual liquids trapped within the unsaturated portion of the source areas is estimated as at least 170,000 gallons.

Additional liquids are likely to be found in drums buried in the source areas. Assuming that one third of the 18,000 drums estimated to be in the Main Pit/Barrel Mound contain organic liquids, an additional 660,000 gallons of liquids may be present that require removal and offsite disposal.

The liquids pumping operation is not expected to remove all of the free fluid found within the source areas due to localized pooling between wells, nor will it address the liquids residing in the unsaturated zone.

The nonaqueous-phase liquids removed from the extraction wells and trenches will be sent to a hazardous waste treatment, storage, and disposal (TSD) facility for incineration.

6.1.6 In-Place Drum Lancing

One method considered to assist in the removal of the liquids remaining in the buried drums was to lance the drums in place. The lancing process would release the liquids for subsequent removal by the wells or through the soil vapor extraction process (see Figure 6-1).

The lancing effort would be accomplished using commercially available construction equipment capable of driving solid spark-resistant Cu-Be rods to subsurface depths greater than 40 feet. The lancing would take place throughout the Barrel Mound and in areas of significant concentration of drums in the Main Pit. Magnetometer data highlighting areas of drum concentrations would be used to select appropriate areas in the Main Pit for lancing.

The lances would be advanced to the bottom of each target area at a nominal triangular spacing of 22 inches. The released liquids would be collected and removed via the extraction wells, a U-shaped trench (described later), or the soil vapor extraction system (described later).

The progress of the lancing operations would be controlled by monitoring the rise of fluid levels in nearby extraction wells. The effort would be made to prevent the accumulation of fluids to greater levels than those that currently exist in the source mounds. Non-aqueous phase liquids (NAPL) released by the lancing process and removed in the liquid extraction system would be sent to a TSD facility for treatment and disposal.

While lancing was considered as an option for the removal of drummed liquids, excavation of drums has several advantages over lancing for the removal of liquids. These include the assurance that all liquids are removed and the elimination of the introduction of additional liquids to the vadose zone on the short-term.

6.1.7 Drum Excavation

Liquids in drums from the Barrel Mound and the west side of the Main Pit can be removed from the source areas by excavating the drums as originally intended in the 1986 ROD instead of performing drum lancing. The excavation option would remove free liquids directly from the surface and from any drummed liquids in the source areas by direct removal. It is expected that excavation, utilized successfully at a number of other sites, would be more efficient than lancing in removing free and containerized liquids in the Main Pit/Barrel Mound. Figure 6-2 indicates areas that would be targeted for drum excavation. Drums that are removed from the source areas would be staged for sampling and consolidation with similar wastes. Drummed organic liquids would be consolidated for offsite treatment and disposal. The liquids would be transported to a hazardous waste treatment, storage and disposal (TSD) facility for incineration. Aqueous liquids would be treated onsite by the groundwater treatment facility. Any drums containing solids, or having solid residues in them after liquids are removed would be placed back into the source areas.

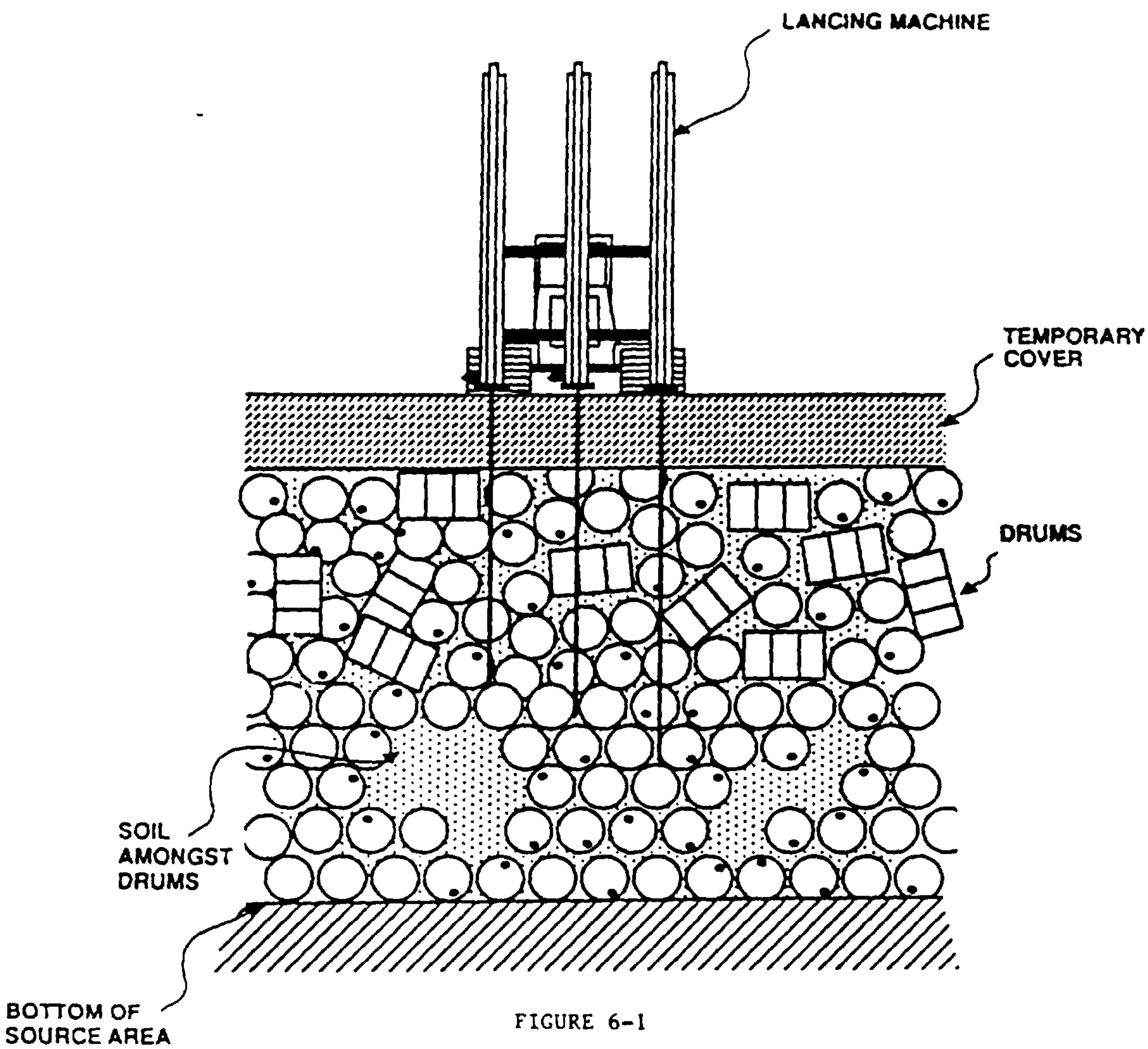
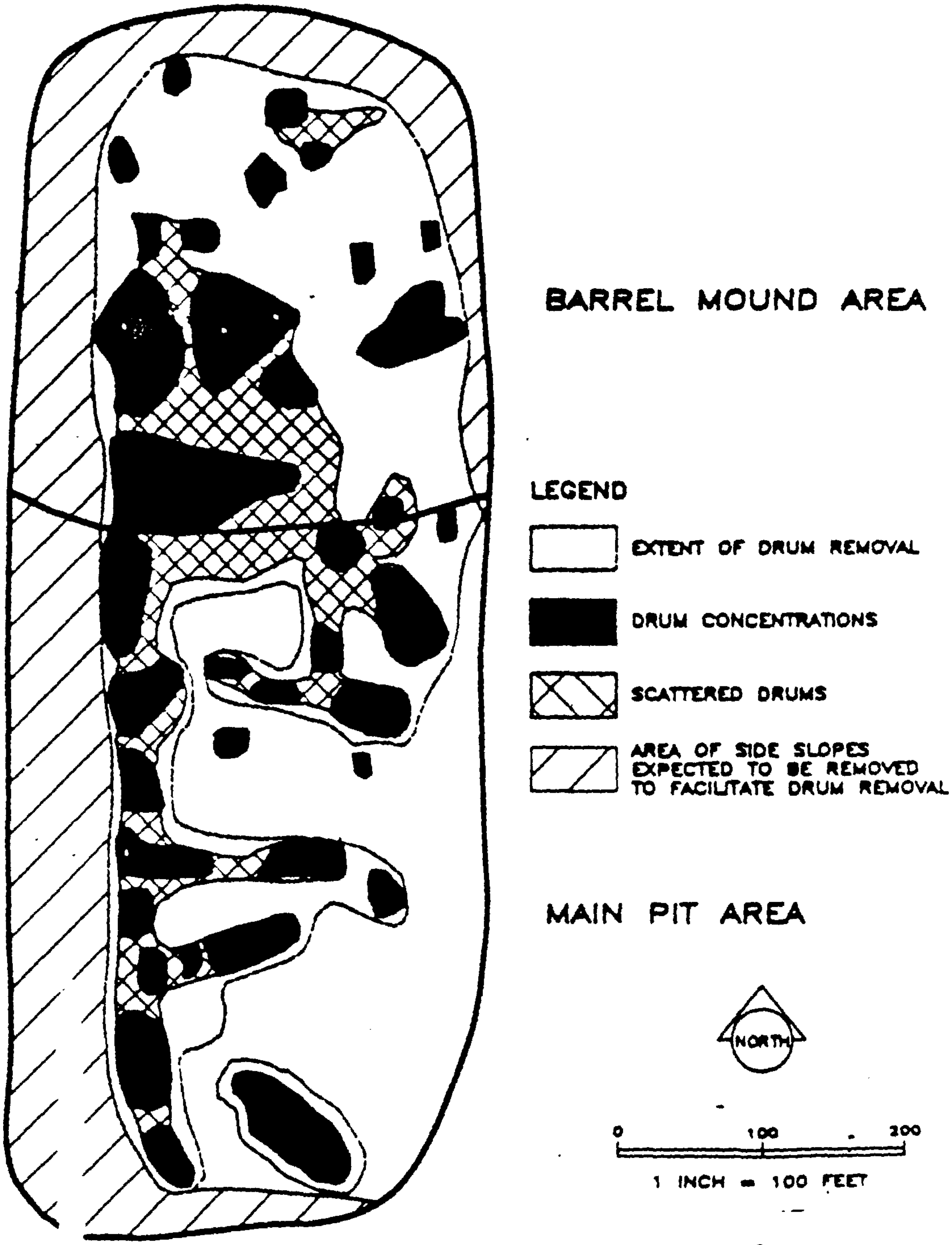



FIGURE 6-1

CONCEPTUAL OPERATION OF DRUM LANCING

FIGURE 6-2
AREAS TARGETED FOR DRUM EXCAVATION



6.1.8 Excavation of Wastes in Adjacent Areas

Contaminated surface soils and waste materials located away from the source areas will be excavated and transported to the source areas. These materials will be consolidated under a temporary cap for soil vapor extraction along with trench excavation materials and other materials generated during implementation of the remedy. The greatest concentration of contaminated soils and wastes away from the source areas occurs in the North Pit area, where up to 80 drums of wastes as well as contaminated soils are believed to be buried, and in the West and East Pond Areas (see Figure 1-2).

If contaminated water or liquid wastes are encountered in these drums, they will be treated in the groundwater treatment facility to surface water discharge standards, or taken offsite for disposal, whichever is appropriate. The contaminated solids and soils will be remediated as part of the overall remediation program, once they are placed within the source areas and capped.

6.1.9 Soil Vapor Extraction and Treatment

Soil vapor extraction would be conducted in the three main source areas as a means to further capture and destroy the liquids present. Soil vapor extraction is expected to remove a large volume of the highly toxic and mobile volatile organic compounds present in the source areas. The soil vapor extraction systems would consist of a network of extraction wells screened in the contaminated (vadose) zone of the Main Pit/Barrel Mound and Sludge Mound. The dual-purpose extraction wells installed to remove liquids would be used as part of the vapor extraction system.

The liquids pumping operation is not expected to remove 100 percent of the liquids present. Numerous field studies have shown that in excess of 40 percent of the available liquids may remain trapped in the unsaturated zone following gravity drainage and pumping efforts. While not readily amenable to pumping, these residual liquids are subject to further removal by vapor extraction.

Soil vapor extraction works by drawing air through areas containing contamination thereby creating a vacuum in the source areas (see Figure 6-3). This, in turn results in a high evaporation rate of volatile and semi-volatile organic compounds, including significant quantities of toxic and carcinogenic contaminants that are in contact with groundwater and atmosphere. Such contaminants evaporate into the air drawn into the mounds. The contaminated air is then extracted through air extraction wells and is treated onsite to destroy the contamination.

If lancing is used, vapor extraction is also expected to remove a significant quantity of the liquids that remain trapped in the drums.

If there are pockets or low spots in the mounds between the liquid extraction wells, the vapor extraction process will further aid in the removal of liquids that cannot migrate towards the extraction wells.

The air stream and vapors removed by the soil vapor extraction system will be treated using the Best Available Control Technology for thermal destruction

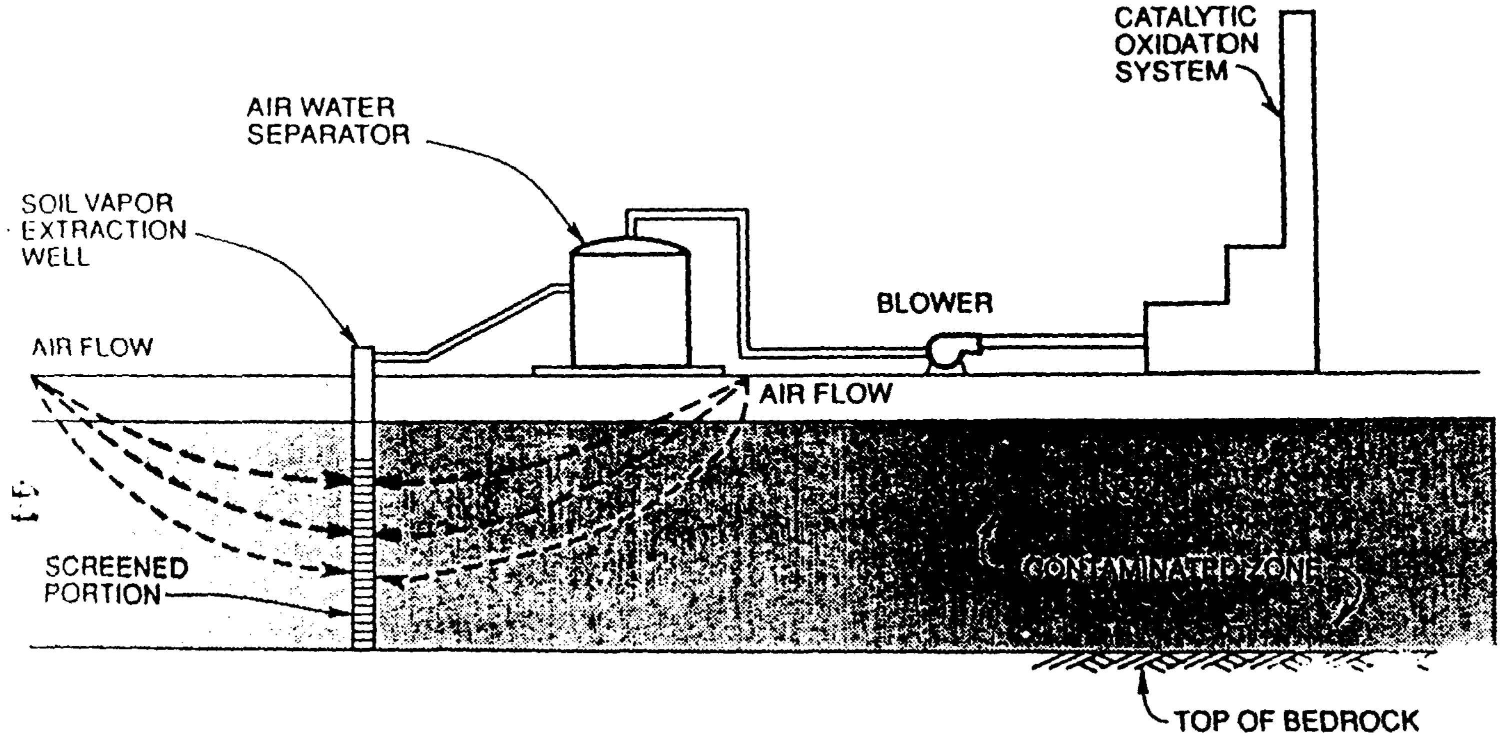



FIGURE 6-3

SOIL VAPOR EXTRACTION--
SCHEMATIC

of toxic vapors prior to discharge to the atmosphere. Vapors generated by the groundwater treatment system will also be destroyed in this thermal treatment system.

6.1.10 Source Area Capping

Two types of source area capping are planned for the site. A temporary cover would be installed during remediation activities, and a permanent RCRA-compliant cap would be installed once soil vapor extraction and liquid extraction activities are complete. The temporary cover will consist of compacted, minimum 1-foot thick, low-permeability soil with vegetation to minimize erosion. Repairs will be made as needed to compensate for damage from settlement and erosion.

Permanent RCRA-cap installation would be initiated once the drummed liquids are removed, soil vapor extraction has been completed, and the liquid extraction wells have been decomissioned. The cap will be location over the Main Pit, Barrel Mound and Sludge Mound areas as illustrated in Figure 6-4.

Section 6.2 Groundwater Remediation Objectives and Alternative Groundwater Components

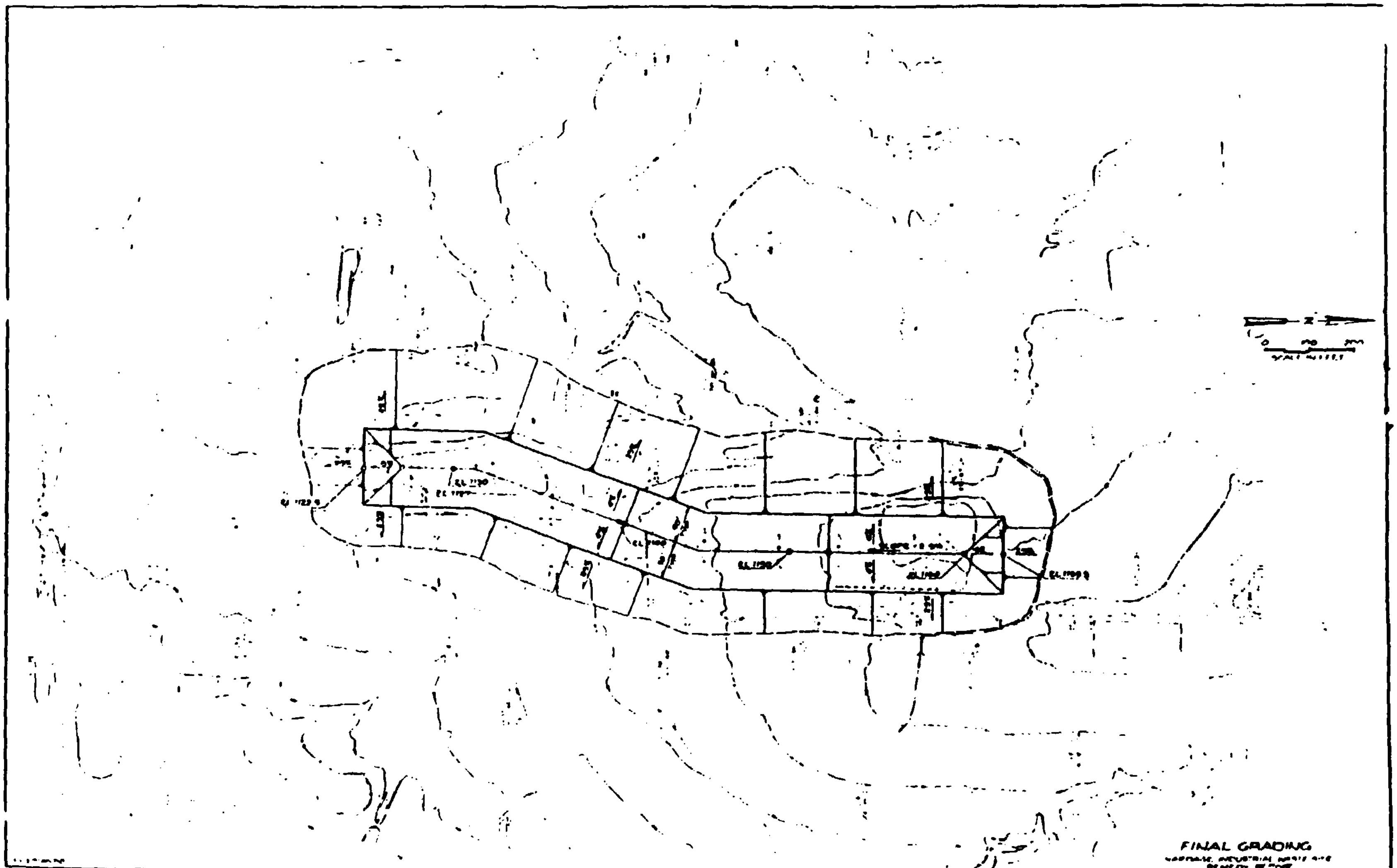
In addition to the new components considered for Source Control, remedial alternatives for contaminated groundwater were developed and described in detail as part of the Management of Migration Operable Unit RI/FS reports. All alternatives were developed assuming some form of concurrent Source Control remedial action. The alternatives were developed in light of the overall goal of restoring groundwater to its beneficial use within a reasonable timeframe.

Consideration of the hydrology and contamination of the bedrock aquifer at the site has led to the conclusion that restoration of bedrock groundwater underneath the source areas is technically impractical over a reasonable time period (a few decades). This conclusion is supported by the fact the some D-NAPL has escaped from the source areas and will continue to serve as as source for dissolved contaminants in groundwater. Also, some contaminants have diffused into dead-end cracks and fine-grained pores in the rock matrix; those materials will take a relatively long time to diffuse out of the pores and cracks during an active or passive restoration program. In view of these facts, the most effective way to address groundwater contamination onsite is through various containment efforts designed to control the spread of groundwater plumes and protect downgradient areas from future plume migration. Such efforts will be significantly aided by source control actions that in a timely manner permanently reduce the potent source liquids which continue to load the groundwater system with contaminants. Consequently, component alternatives were screened and refined based on their effectiveness in meeting the following objectives:

o intercept and capture groundwater that is migrating towards the alluvial aquifer and the east farm ponds, thereby protecting offsite areas from future contaminant impacts, and commencing the process of natural restoration in the alluvial system;

FIGURE 4-4

FINAL SOURCE AREA CAP



- o monitor and control contaminated groundwater discharge to North Criner Creek to assure that Oklahoma Water Quality Standards for North Criner Creek and Criner Creek are met; and
- o prevent domestic and agricultural use of contaminated groundwater through continued supply of alternate water to affected residents.

In view of these objectives, ERM-Southwest, on behalf of the HSC (and pursuant to a partial Consent Decree with EPA) developed and evaluated 21 remedial action alternatives by combining 6 remedy elements (see Table 6-1). Details of this analysis is presented in the Management of Migration FS. All of the initial alternatives developed included groundwater and surface water monitoring, as well as actions to minimize runoff from the source areas. All alternatives relied on institutional controls (such as deed restrictions) to prevent the use of potentially contaminated groundwater as a drinking water supply. The alternatives also included continued operation of alternate water supplies to nearby residents.

Screening of these alternatives was conducted in the FS based on effectiveness in containing and capturing contamination, and cost. Six groundwater alternatives were retained after this screening for detailed analysis, and were summarized below:

| Alternative | Description |
|---|---|
| A | No Action |
| B | Primary Controls - institutional controls on groundwater use, maintenance of alternate water supplies, and surface water controls to limit the discharge of contaminated groundwater to surface water. |
| C | Alternative B and Alluvial Recovery - groundwater recovery from the North Criner Creek alluvium using a well network or interceptor trench system (see Figure 6-5) |
| E | Alternative B and Alluvial, South Pond and Southeast Area Recovery - groundwater recovery from the North Criner Creek alluvium, from bedrock southwest of the Main Pit, Barrel Mound and Sludge Mound, and from bedrock east and southeast of these three source areas (see Figure 6-6) using a well network or interceptor trench system |
| K | Alternative B and South Pond Area Recovery - groundwater recovery from bedrock southwest of the three main source areas using a well network or trench system, with the the option of a local cut-off wall along the site fence boundary in place of a number of recovery wells |
| N | Alternative B and Main Source Area Recovery - groundwater recovery associated with source control measures using a well network. |

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Revision #0
May 30, 1989

# TABLE 6-1

Summary of Alternative Elements

Second Operable Unit Feasibility Study
Royal Hardage Site
Criner, Oklahoma

| Remedy Elements | Monitoring | Primary Controls | Alluvial Recovery | In Situ Bio-remediation | South Pond Area Recovery | Southeast Recovery | Recovery Trench |
|---|---|---|---|---|---|---|---|
| A "No Action" | x | | | | | | |
| B Primary Controls | x | x | | | | | |
| C Primary Controls and Alluvial Ground Water Recovery | x | x | x | | | | |
| D Primary Controls, Alluvial and South Pond Area Recovery | x | x | x | | x | | |
| E Primary Controls, Alluvial South Pond Area and Southeast Recovery | x | x | x | | x | x | |
| F Primary Controls, Alluvial and Southeast Recovery | x | x | x | | | x | |
| G Primary Controls and In Situ Bioremediation | x | x | | x | | | |
| H: Primary Controls, In Situ Bioremediation and South Pond Area Recovery | x | x | | x | x | | |
| I: Primary Controls, In Situ Bioremediation, South Pond Area and Southeast Recovery | x | x | | x | x | x | |
| J: Primary Controls, In Situ Bioremediation, and Southeast Recovery | x | x | | x | | x | |
| K Primary Controls, and South Pond Area Recovery | x | x | | | x | | |

# TABLE 6-1 (continued)

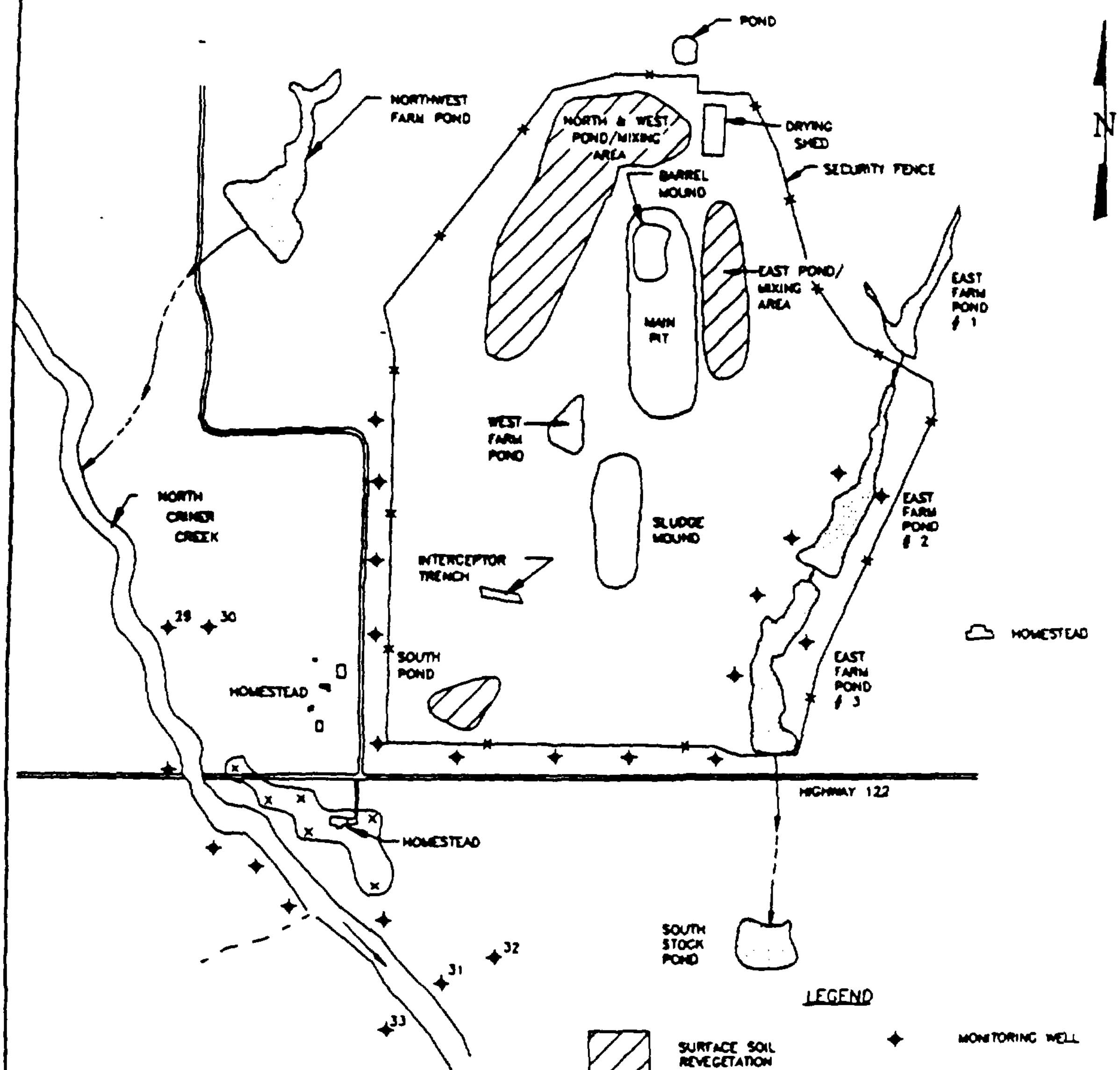


Summary of Alternative Elements

Second Operable Unit Feasibility Study
Royal Hardage Site
Criner, Oklahoma

| Remedy Elements | Monitoring | Primary Controls | Alluvial Recovery | In Situ Bio-remediation | South Pond Area Recovery | Southeast Recovery | Recovery Trench |
|---|---|---|---|---|---|---|---|
| 1L Primary Controls South Pond Area and Southeast Recovery | x | x | | | x | x | |
| 1M Primary Controls and Southeast Recovery | x | x | | | | x | |
| 1N Primary Controls and Main Source Area Recovery | x | x | | | | | |
| 1O Primary Controls, Alluvial Recovery and Main Source Area Recovery | x | x | | | | | x |
| 1P Primary Controls, Alluvial and South Pond Area Recovery and Main Source Area Recovery | x | x | x | | x | | x |
| 1Q Primary Controls, In Situ Bioremediation, and Main Source Area Recovery | x | x | | x | | | x |
| 1R Primary Controls, In Situ Bioremediation, South Pond Area Recovery and Main Source Area Recovery | x | x | | x | x | | x |
| 1S Primary Controls, South Pond Area Recovery and Main Source Area Recovery | x | x | | | x | | x |
| 1T Primary Controls, Main Source Area Recovery, Southeast and South Pond Recovery | x | x | | | x | x | x |
| 1U Primary Controls, Alluvial, South Pond, Southeast Recovery and Main Source Area Recovery | x | x | x | | x | x | x |

NOTES
"x" indicates element is included in potential remediation alternative for screening purposes




WELL LOCATIONS AND NUMBERS ARE APPROXIMATE AND ARE SHOWN FOR CONCEPT ILLUSTRATION PURPOSES ONLY.

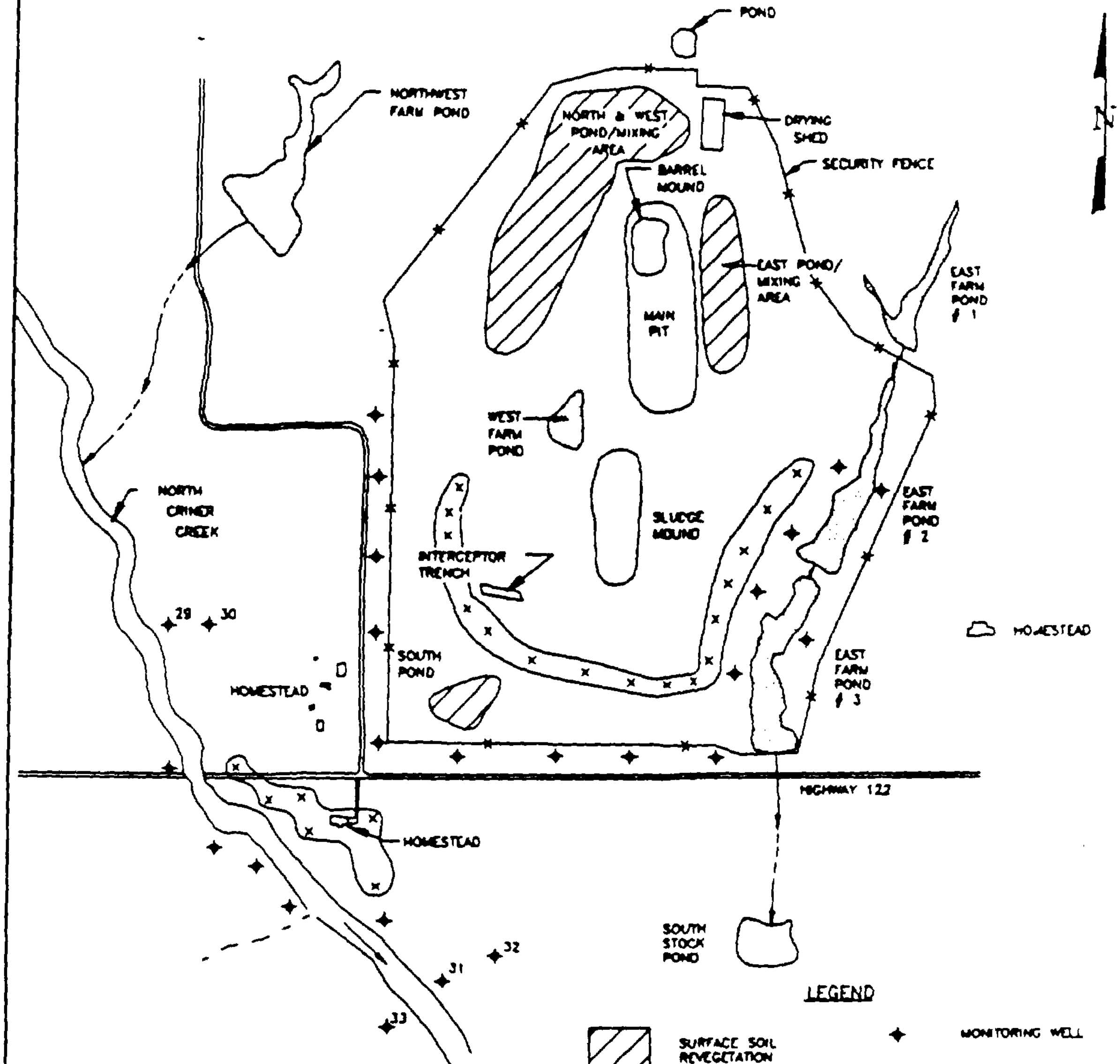
SOIL REVEGETATION AREAS ARE NOT EXACT AND ARE SHOWN FOR CONCEPT ILLUSTRATION PURPOSES ONLY.

**ERM-Southwest, inc.**
NEW ORLEANS, LOUISIANA HOUSTON, TEXAS

DATE 05/24/89 | W.O. 7663A001E89

FIGU 6-5

ALTERNATIVE C S SCHEMATIC
SECOND OPERABLE UNI FEASIBILITY STUDY
ROYAL HARD E SITE
CRINER, O HOMA

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NEW ORLEANS, LOUISIANA HOUSTON, TEXAS

DATE 05/24/89 | W.O.NO. 7663A001E89

FIGURE 6-6

ALTERNATIVE E SITE SCHE 'ATIC
SECOND OPERABLE UNIT FEASIE .ITY STUDY
ROYAL HARDAGE SITE
CRINER, OKLAHOMA

Alternative E (illustrated in Figure 6-6) involves the recovery of contaminated groundwater in the southwest alluvial area of North Criner Creek and onsite groundwater recovery west, south, and east of the main source areas. Alternative E has been modified and includes two groundwater components. The onsite interceptor system is known as the V-Shaped Trench. The southwest interceptor system is known as the Southwest Interceptor Trench. Both the V-shaped and Southwest interceptor trenches would be capable, in combination with Source Control components of the comprehensive remedy, of modifying groundwater gradients at the site so as to contain and capture groundwater and D-NAPL migrating from the source areas and off the site.

A third trench, known as the U-Shaped Trench, was considered by EPA during the development of groundwater alternatives in order to prevent uncontaminated groundwater in the vicinity of the Main Pit/Barrel Mound from coming into contact with the source waste materials during remediation, as well as to support source liquids removal operations by intercepting lateral seepage that may ensue from the source areas.

These three recovery systems could be installed at the site to capture contaminated groundwater migrating towards the alluvium and the east farm ponds, provided Source Control measures are also instituted. Collected groundwater from any or all of these systems would be treated onsite to discharge standards before discharge to North Criner Creek. These collection systems are illustrated in Figure 6-7 and each is further described below:

### 6.2.1 U-shaped Trench

The first trench, known as the U-shaped trench, would intercept shallow seepage issuing laterally from the Barrel Mound and the Main Pit and to collect contaminated groundwater from Stratum I in the vicinity of the Barrel Mound and Main Pit.

### 6.2.2 V-shaped Trench

The V-shaped trench would intercept and collect contaminated groundwater from all bedrock zones existing above Stratum IV. The trench will be located so that groundwater contaminants already migrating eastward towards the east farm ponds will be captured by the trench, negating the need for additional gorundwater recovery measures east and southeast of the trench.

### 6.2.3 Southwest Interceptor Trench

The Southwest Interceptor Trench is to intercept and collect contaminated bedrock system groundwater prior to its natural discharge to the offsite alluvial aquifer along North Criner Creek. The trench will extend to Stratum IV and will collect contaminated groundwater from all bedrock zones above Stratum IV. A system of extraction wells could be used as an alternative to the Southwest Interceptor Trench provided they are equally effective at intercepting and collecting contaminated groundwater.

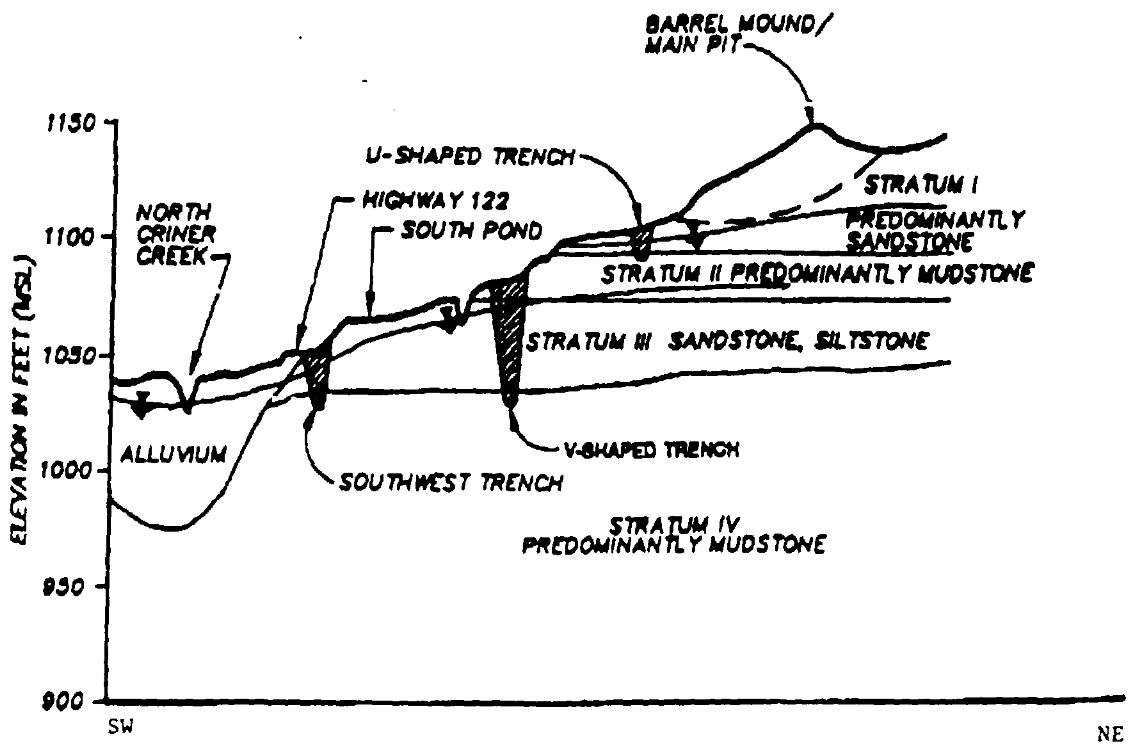


FIGURE 7

SITE CROSS SECTION
SHOWING TRENCHES

6.2.4 Ground Water Treatment System

An onsite treatment plant would be provided to treat collected groundwater and surface water. The plant would be sized to handle flows from the groundwater collection trenches and the surface water collection system. The plant incorporates appropriate treatment processes to handle both organic and inorganic contaminants as necessary.

Following treatment, the plant would discharge to North Criner Creek. The plant would be designed to meet the applicable discharge requirements set by the Oklahoma Water Resources Board and the Oklahoma State Department of Health.

6.2.5 Alluvial Ground Water Restoration

Contaminants already present in the alluvial aquifer would be allowed to dissipate by natural dilution, biodegradation, and flushing. Future contaminant inputs to the aquifer will be abated by the trenches and the Source Control elements presented above to allow restoration to Maximum Contaminant Levels in the North Criner Creek alluvium. If alluvial monitoring reveals that estimated natural restoration time and plume dilution rates are not being met, then active restoration would be implemented. An increase in contaminant concentrations in the alluvium after trench installation and pumping, or a decline in the mass of contaminants of less than 40 percent in 10 years, would trigger active restoration in the alluvium.

## 6.3 Monitoring and Support Components

6.3.1 Remedial Support Facilities

Several components are needed to support the implementation of the remedy. These site control facilities consist of a command post, medical services station, close support analytical laboratory, sanitary facility, equipment maintenance shop, decontamination facilities for both equipment and personnel, and a supply center, gate guard, and communication center.

6.3.2 Institutional Controls

Institutional controls, including fencing, deed restrictions, and maintenance of the availability of an alternate water supply system would be implemented to restrict access to the site and contaminated groundwater.

6.3.3 Surface Water Controls

During implementation of the remedy, surface water drainage from the sourc areas would be collected as needed. Berms would be constructed to divert uncontaminated runoff water away from the working area to minimize the generation of contaminated water. A retention pond would be used to colle.t and store surface water prior to treatment. A Treated Water Retention Por would also be used to store treated groundwater prior to discharge to the surface drainage system for North Criner Creek.

Once the temporary cover is in place and the remedy has been implemented, surface water control and treatment would not be necessary. The diversions would be maintained over the life of the remedy as a means to control erosion of the cover.

### 6.3.4 Remedial Monitoring

A monitoring program would be instituted as part of the remedy to verify that the migration of contaminants has been halted. Streamwater in North Criner Creek would be monitored periodically for an indefinite future time to provide assurance that surface water discharge limits are not being exceeded downstream.

A line of monitoring wells at the downstream end of the alluvial contamination plume would be used to provide assurance that the plume is not expanding downgradient in the alluvial aquifer above acceptable levels.

The quantity and quality of liquids collected from the trenches would also be monitored. The effectiveness of the trenches in maintaining the desired hydraulic gradients and capture zones will be monitored by a series of piezometers positioned along lines perpendicular to the orientation of the trenches.

Bedrock groundwater monitoring wells (both new and existing) would be used to further verify the effectiveness of the trenches in controlling the spread of contaminated ground water.

The cap will also be monitored periodically to assure that differential settlement or erosion processes are not compromising the integrity of the caps.

Monitoring would be used to verify that the quality of downstream water resources is not being jeopardized during the natural restoration process.

Air quality would be monitored both onsite and at the site fenceline to assure that both onsite action levels and Maximum Ambient Air Concentrations are being met during remedy implementation.

## 6.4 Comprehensive Alternatives

From all of the components described in Sections 6.1, 6.2 and 6.3, three comprehensive remedial alternatives were assembled for consideration. These three alternatives, the Revised EPA Remedy, the Partially Revised EPA Remedy, and the HSC Remedy are described below and in Table 6-2.

6.4.1 Common Elements

Certain of the components from Section 6.1 are included in all three of the comprehensive alternatives. These are Institutional Controls (6.3.2), Surface Water Controls (6.3.3), Remedial Monitoring (6.3.4), and Remedial Support Facilities (6.3.1)

6.4.2 Revised EPA Remedy

The Revised EPA Remedy is a new source control remedy combined with groundwater collection and treatment. This remedy would remove a substantial portion of the liquid wastes, including many highly toxic and mobile volatile organic compounds, from source areas, thereby reducing the volume, toxicity and mobility of hazardous substances at the site. It calls for:

- Liquid Extraction Wells (6.1.5)
- In-Place Drum Lancing (6.1.6)
- Excavation of Wastes in Adjacent Areas (6.1.8)
- Soil Vapor Extraction and Treatment (6.1.9)
- Source Area Capping (6.10)
- U-shaped Trench (6.2.1)
- V-shaped Trench (6.2.2)
- Southwest Interceptor Trench (6.2.3)
- Groundwater Treatment (6.2.4)
- Alluvial Groundwater Restoration (6.2.5)

6.4.3 Partially Revised EPA Remedy

This remedy is essentially the same as the Revised EPA Remedy except that the buried drum concentrations in the Main Pit and Barrel Mound would be excavated (6.1.7) rather than lanced, and the U-shaped trench would not be needed. The use of excavation assures that all drummed liquids are removed and eliminates the short-term introduction of additional free liquids to the vadose zone resulting form lancing.

6.3.4 The HSC Remedy

This remedy is described in the Remedy Status Report which the HSC filed with the Federal District court in Oklahoma City on June 30, 1989 and described in greater detail in the HSC's Preliminary Design Report dated October 12, 1989, and also filed with the Court. It includes the following elements:

- Liquid Extraction Wells (6.1.5)
- V-shaped Trench (6.2.2)
- Southwest Interceptor Trench (6.2.3)
- Excavation of Wastes in Adjacent Areas (6.1.8)
- Groundwater Treatment (6.2.4)
- Alluvial Ground Water Restoration (6.2.5)

The HSC Remedy also includes capping of the three main source areas, but with a less effective cap than that proposed in the EPA remedies. The HSC cap does not meet RCRA requirements.

TABLE 6-2

## HARDAGE SITE
## COMPARISON OF ALTERNATIVES

| | HSC REMEDY | REVISED EPA REMEDY | PARTIALLY REVISED EPA REMEDY |
|---|---|---|---|
| **SOURCE CONTROL** | | | |
| Excavation of Drums | | | ✖ |
| Liquid Extraction Wells | ✖ | ✖ | ✖ |
| Drum Lancing | | ✖ | |
| U-Shaped Trench | | ✖ | |
| Soil Vapor Extraction | | ✖ | ✖ |
| Consolidation & Capping | ✖ | ✖ | ✖ |
| **GROUNDWATER** | | | |
| V-Shaped Trench | ✖ | ✖ | ✖ |
| Alluvial Recovery | ✖ | ✖ | ✖ |
| Common Groundwater Elements | ✖ | ✖ | ✖ |

The HSC remedy does not contain the following Source Control components integral to both of the EPA remedies:

- Drum Excavation (6.1.7)
- Soil Vapor Extraction and Treatment (6.1.9)
- In-Place Drum Lancing (6.1.6) & U-shaped Trench (6.2.1) (in Revised Remedy)

A comparative analysis of each of these remedies is the subject of Section 7.

7.0 Comparative Anaysis

The remedial alternatives described in Section 6 have been assessed in light of criteria defined in CERCLA Section 121. This Section of CERCLA specifies that remedial actions must:

- Be protective of human health and the environment;

- Attain applicable or relevant and appropriate requirements (ARARs);

- Be cost-effective;

- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable;

- Satisfy the preference for treatment that reduces volume, toxicity, or mobility as a principal element or provide an explanation in the ROD as to why it does not.

In addition, CERCLA places an emphasis on evaluating long-term effectiveness and related considerations for each of the alternative remedial actions (§121(b)(1)(A)). These statutory considerations include:

A) the long-term uncertainties associated with land disposal;

B) the goals, objectives, and requirements of the Solid Waste Disposal Act (i.e., RCRA)

C) the persistence, toxicity, and mobility of hazardous substances and their constituents, and their propensity to bioaccumulate;

D) short- and long-term potential for adverse health effects from human exposure;

E) long-term maintenance costs;

F) the potential for future remedial action costs if the alternative remedial action in question were to fail; and

G) the potential threat to human health and the environment associated with excavation, transportation, and redisposal or containment.

Nine evaluation criteria have been developed to address the CERCLA requirements and considerations listed above, and to address the additional technical and policy considerations that have proven to be important for selecting among remedial alternatives. These nine criteria are discussed in a memorandum entitled "Interim Guidance on Superfund Selection of Remedy" from J. Winston Porter, Assistant Administrator dated December 24, 1986. The nine criteria are organized into three groups:

Threshold Criteria:

1. Overall protection of human health and the environment;

2. Compliance with applicable or relevant and appropriate requirements (ARARs);

Primary Balancing Criteria:

3. Long-term effectiveness and permanence;

4. Reduction of volume, toxicity and mobility through treatment;

5. Short-term effectiveness;

6. Implementability;

7. Cost

Modifying Criteria:

8. State acceptance;

9. Community acceptance.

If an alternative satisfies the threshold criteria, it is eligible for further analysis under the Primary Balancing criteria. The comparison of alternatives is given below as well as in Table 7-1. This comparative analysis provides the basis for EPA preference for the EPA excavation remedy.

7.1 Overall Protection of Human Health and the Environment:

The EPA excavation remedy provides the most overall protection of human and the environment. Both the EPA remedies provide short-term protection through the provision of alternate water supply the maintenance of site security, and land use controls to prevent exposure to contaminated groundwater. Although the EPA excavation remedy involves certain additional short-term risks in implementation, these risks can be significantly reduced or eliminated, primarily through controls on the emission of vapors and dust during excavation.

The EPA remedies provide long-term protection through the removal of a substantial volume the most highly toxic and mobile contaminants present in the source areas. The EPA excavation remedy is more effective in the removal of these contaminants than the EPA lancing remedy. Further long-term protection is provided by continued monitoring to assure that the remedy components continue to function as expected.

The HSC remedy provides the least overall protection of human health and the environment, particularly over the long-term. It would leave a large volume of untreated, toxic and mobile compounds, both in buried drums and in source area soils. These contaminants would pose a continuing threat threat to human health and the environment. The HSC remedy does not address the liquids from the source areas until they have migrated to the interceptor trenches. This process will take a long period of time, resulting in considerable uncertainty. The HSC remedy also relies on institutional controls to limit exposure to contaminated groundwater and surface water. The long-term maintenance of institutional controls

Table 7-1
COMPARISON SUMMARY ACCORDING TO STATUTORY CRITERIA

1. **Overall Protection of Human Health and the Environment**

| HSC's Remedy | EPA's Remedy With Lancing | EPA's Remedy With Excavation |
|---|---|---|
| • Leaves drummed and adsorbed wastes/contaminants in the Sludge Mound and Main Pit/Barrel Mound resulting in long-term presence of contaminant sources onsite. More specifically, drums will corrode over time releasing their contents, and vadose/adsorbed contaminants would remain as a source of contamination. | • Reduces the magnitude of long-term risks to human health and the environment. | • Reduces the magnitude of long-term risks to human health and the environment. |
| • Downward and horizontal migration of contaminants from sources left in place poses long-term risks (100's of years) which will need to be monitored. | • Removes a significant mass of contaminants from the environment (drums, soils in Main Pit/Barrel Mound and Sludge Mound) through the use of soil vapor extraction (SVE) enhanced by lancing, and liquid extraction wells. | • Removes a significant mass of contaminants from the environment (drums, soils in Main Pit/Barrel Mound and Sludge Mound) through the use of SVE combined with removal of liquids by drum excavation and extraction wells. |
| • Requires increased reliance on institutional controls. | • Meets statutory preference for utilizing treatment technology which permanently reduces the source term. Minimizes the volume/mass of contaminants subject to long-term storage/monitoring. | • Meets statutory preference for utilizing treatment technology that permanently reduces the source term. Minimizes the volume/mass of contaminants subject to long-term storage/monitoring. |
| • Releases to air will also occur to a greater extent over the long term. | • Reduces the potential for contaminants being released from sources, migrating away from sources, and escaping from down-gradient collection areas and offsite. | • Reduces the potential for contaminants being released from sources, migrating away from sources, and escaping from down-gradient collection areas and offsite. |

2. Compliance With ARARs

| HSC's Remedy | EPA's Remedy With Lancing | EPA's Remedy With Excavation |
|---|---|---|
| • Will need to meet surface water discharge standards.<br><br>• Would not meet requirements of RCRA for unit closure as a hazardous waste management unit (eg., would allow migration between source areas and V-Shaped Trench). | • Will need to meet surface water discharge standards.<br><br>• Can be designed to work with best available control technology (BACT) for air treatment (technology ARAR).<br><br>• These alternatives involve SVE and the collection of vapors and treatment. Treatment will meet ARARs contained in the Oklahoma 3.8 regulations that allow for maximum ambient air concentration (MAAC) exceedances as long as monitoring and risk assessments assure safety. | • Will need to meet surface water discharge standards.<br><br>• Can be designed to work with BACT for air treatment (technology ARAR)<br><br>• These alternatives involve SVE and the collection of vapors and treatment. Treatment will meet ARARs contained in the Oklahoma 3.8 regulations that allow for MAAC exceedances as long as monitoring and risk assessments assure safety. |

**Table 7-1**
**(Continued)**

**3. Long-Term Effectiveness**

| HSC's Remedy | EPA's Remedy With Lancing | EPA's Remedy With Excavation |
|---|---|---|
| • The remaining sources of risk and the magnitude of the residual risk will be greater because the HSC's remedy does not remove the mass of contaminants that the EPA's remedy does. | • Provides for greater long-term effectiveness by removing a significant mass of contaminants and therefore decreases the magnitude of the residual risk. | • Provides for greater long-term effectiveness by removing a significant mass of contaminants and therefore decreases the magnitude of the residual risk. |
| • It is unlikely that the V-Shaped Trench will meet its intended objectives of intercepting and removing DNAPLS from the Main Pit and Barrel Mound. | • The degree of long-term management necessary will be minimized because contaminants are removed and treated. | • The degree of long-term management necessary will be minimized because contaminants are removed and treated. |
| • Would require very long-term (indefinite) operation of the V-Shaped Trench and the liquid extraction wells to remove liquids from the Main Pit/Barrel Mound. | • SVE is a treatment technology that permanently removes contaminants from the Main Pit/Barrel Mound and Sludge Mound, resulting in a reduced waste mass and reduced source of contaminants to groundwater and air. | • SVE is a treatment technology that permanently removes contaminants from the Main Pit/Barrel Mound and Sludge Mound, resulting in a reduced waste mass and reduced source of contaminants to groundwater and air. |
| | | • Excavation is a treatment technology that directly removes contaminants from the Main Pit/Barrel Mound and further reduces the waste m[illegible] for contaminated migration. |

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**Table 7-1**
**(Continued)**

**4. Reduction of toxicity, mobility, or volume through treatment**

| HSC's Remedy | EPA's Remedy With Lancing | EPA's Remedy With Excavation |
|---|---|---|
| • Does not treat sources at the site to the maximum extent possible and, therefore, does not reduce the same volume of contaminants that the EPA's remedy does.<br><br>• The mobility of the contaminants that are not treated will increase with time as the drums corrode and release liquids.<br><br>• Does not satisfy the statutory preference for treatment as a principal element of the remedy.<br><br>• Allows mobility between the three source areas and the V-Shaped Trench, whereas EPA's remedy prevents this. | • Treatment-based remedy that addresses each of the sources and media at the site.<br><br>• Removal and destruction of contaminants is irreversible.<br><br>• Satisfies the statutory preference for treatment as a principal element of a remedy.<br><br>• The volatiles removed via soil vapor extraction are among the most toxic at the site and, therefore, a significant reduction in toxicity is provided and hence residual risk to human health and the environment.<br><br>• Lancing with liquids extraction removes toxic and hazardous wastes from the site. | • Treatment-based remedy that addresses each of the sources and media at the site.<br><br>• Removal and destruction of contaminants is irreversible.<br><br>• Satisfies the statutory preference for treatment as a principal element of a remedy.<br><br>• The volatiles removed via soil vapor extraction are among the most toxic at the site and, therefore, a significant reduction in toxicity is provided and hence residual risk to human health and the environment.<br><br>• Excavation further removes toxic hazardous wastes from the site. |

**Table 7-1**
**(Continued)**

**5. Short-Term Effectiveness**

| HSC's Remedy | EPA's Remedy With Lancing | EPA's Remedy With Excavation |
|---|---|---|
| • Vapors currently dispersing into the atmosphere at the site will be reduced by capping.<br><br>• Impacts on community during remediations will be minimal<br><br>• Vapors from liquid extraction and temporary onsite storage will be controlled.<br><br>• Vapors from groundwater treatment will be controlled through BACT. | • Area residents will be protected from contaminant releases by treating SVE air stream with catalytic oxidation.<br><br>• Impacts on community during implementation will be minimal.<br><br>• Controlled or remote lancing will be used if worker risks during lancing are unacceptable.<br><br>• Vapors will be produced from SVE and treated onsite to meet ARARs. In the event that MAACs, are exceeded, particularly during early periods of SVE operation, levels will be monitored continuously at the fence lines and stack, and releases minimized through pilot testing during design implementation.<br><br>• Controlled lancing, but untested here. | • Area residents will be protected from contaminant releases by treating SVE air stream with catalytic oxidation.<br><br>• Impacts on community during excavation will be evident but controllable.<br><br>• Vapors will be produced from SVE and treated onsite to meet ARARs. In the event that MAACs are exceeded, particularly during early periods of SVE operation, levels will be monitored continuously at the fence lines and stack, and releases minimized through [illegible] during [illegible] implementation.<br><br>• Proven technology, controlled risks. |

**Table 7-1**
**(Continued)**

5. **Short-Term Effectiveness** (continued)

| HSC's Remedy | EPA's Remedy With Lancing | EPA's Remedy With Excavation |
|---|---|---|
| | • Vapors from liquid extraction and temporary onsite storage will be controlled (treated).<br>• Risk exists from the mixing of incompatible wastes | • Vapors from excavation and temporary onsite storage of liquid wastes will be controlled (treated). |

**Table 7-1**
**(Continued)**

**6. Implementability**

| HSC's Remedy | EPA's Remedy With Lancing | EPA's Remedy With Excavation |
|---|---|---|
| • Technologies and technology components are implementable. | • SVE systems have been constructed and successfully operated at sites with similar characteristics.<br>• Lancing has been demonstrated in the field, except at a hazardous waste site.<br>• Trenching, capping, liquids extraction, water treatment, and air treatment are proven technologies. | • SVE systems have been constructed and successfully operated at sites with similar characteristics.<br>• Trenching, capping, liquids extraction, water treatment, and air treatment are proven technologies.<br>• Excavation of drummed wastes has been successfully completed at other hazardous waste sites. |

**Table 7-1**
**(Continued)**

7. Costs

| HSC's Remedy | EPA's Remedy With Lancing | EPA's Remedy With Extraction |
|---|---|---|
| • Capital Cost = $26.88 - $40.32 million | • Capital Cost = $43.9 million | • Capital Cost = $48.6 million |
| • Annual O&M = $720,000 - $960,000 | • Annual O&M = $1.4 million | • Annual O&M = $1.3 million |
| • 30-year Present Worth = $36.4 million - $54.6 million | • 30-year Present Worth = $58.9 million | • 30-year Present Worth = $62.9 million |

Table 7-1

(Continued)

8. State Acceptance

| HSC's Remedy | EPA's Remedy With Lancing | EPA's Remedy With Excavation |
|---|---|---|
| * Components are acceptable, but State would prefer more removal. | * State supports all ground water removal and treatment elements. | * State supports all ground water removal and treatment elements. |
| * State supports common remedy elements. | * State supports common remedy elements. | * State supports common remedy elements. |
| | * State has concerns regarding safety of drum lancing and risk to workers and the public. | * State has concerns regarding safety of excavation and risk to workers and the public. |
| | * State supports liquid extraction, excavation of adjacent areas, capping, and soil vapor extraction. | * State supports liquid extraction excavation of adjacent areas, capping, and soil vapor extraction. |

Table 7-1
(Continued)

9. Community Acceptance

| HSC's Remedy | EPA's Remedy With Lancing | EPA's Remedy With Excavation |
|---|---|---|
| * Community prefers more removal and destruction of contaminant sources. | * Community supports additional removal and destruction in the EPA remedy. | * Community supports additional removal and destruciton in the EPA remedy. |

results in further uncertainty.

The EPA remedies take a more direct approach to protection of human health and the environment. The first element of this is the removal of contaminants from the source areas and destroying them. By removing and destroying the contamination at the source, any uncertainties as to their future threat are minimized.

The threat to human health and the environment is most acute from those wastes which migrate the easiest and by those which are known or suspected to cause cancer. The EPA remedies both protect human health and the environment through the rapid removal and destruction of those contaminants that are the most mobile and carcinogenic. Both minimize contaminant migration through the elimination of contaminants at the source not only through removal of liquids through extraction wells and either excavation or lancing of drums, but have the added protection of soil vapor extraction (SVE). The SVE system is predicted to remove 99% of the volatile, carcinogenic wastes from the source areas. When they are destroyed following their removal the threat from these contaminants will have been eliminated. In addition to controlling the contamination at the source, the EPA remedies also protect against those contaminants which remain through the groundwater recovery trenches and elimination of infiltration with a regulatorily compliant cap. Therefore, the EPA remedies have the multiple protection of extensive removal and destruction of the contaminant sources combined with a groundwater collection and treatment system to capture any residual contamination. The primary element of the HSC remedy, on the other hand, is groundwater capture and treatment alone.

In terms of two EPA proposals, the comparison is basically between the excavation of the buried drums or lancing them in association with the U-shaped trench. Both activities have elements of risk associated with implementation, but the risk associated with excavation of the drums is less than that of lancing as discussed in Sections 6.1.6 and 6.1.7. . Therefore the combined remedy retaining excavation of the drums is overall, more protective.

7.2 Compliance with ARARS:

Section 121 of CERCLA provides that, except under certain narrow exemptions, remedial actions shall comply with Federal and State laws that are legally applicable or relevant and appropriate to the contaminants and circumstances of the site. The process by which potential ARARs are identified, screened, and analyzed to determine if they actually are ARARs is described in "CERCLA Compliance with Other Laws Manual" (EPA 1988a). The alternatives described in Section 6.4 are broken down below into remedial elements to facilitate the analysis:

ARARs may be identified in three general classes:

1. chemical specific - for example, a drinking water "MCL" defines a maximum acceptable concentration for drinking water;

2. action specific - for example, a landfill built to accept hazardous wastes would have to meet RCRA 264, Subpart N regulations and associated requirements on design of the landfill;

3. location specific - for example, the hazardous waste landfill described above could not be built on a flood plain.

Key among those ARARs, shown in more detail in Appendix A, are the chemical specific drinking water requirements or Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act, and the requirements under the Resource Conservation and Recovery Act (RCRA) which relate to the construction of hazardous waste facilities and their closure. Table 4-2 gives the chemical specific MCLs that would apply to those contaminants that have already migrated into the North Criner Creek alluvium. None of the alternatives would result in rapid restoration of the groundwater onsite to drinking water standards. However, the two EPA remedies would accomplish this goal more rapidly than the HSC through the elimination of contaminant sources. The HSC remedy would also fail to meet the RCRA requirements for its cap. The RCRA requirements for the construction of caps are very specific and the HSC cap does not meet them. The cap proposed under the EPA remedies would meet these requirements.

7.3 Long-term Effectiveness and Permenance

Both of the EPA remedies emphasize recovery and destruction of the contamination at the source. Through the removal of the liquids still contained in the drums, and of contaminants in the contaminated soils and sludges through soil vapor extraction, direct elimination of contaminants at their source is achieved. These contaminants are then destroyed through treatment. It is through this early removal of the contaminants at their source that the EPA alternatives are superior to the HSC alternative. Long-term effectiveness is dependent upon the performance of the alternative over time. This long-term effectiveness is best enhanced through the elimination of uncertainties associated with an alternative. The greatest uncertainty with these alternatives is the potential for long-term migration of contaminants out of the source areas. The uncertainty of the capture of migrating contaminants by the groundwater trenches will always remain and will grow as the time of operation needed for those trenches increases. The EPA remedies effectively address these uncertainties through the elimination of contaminants at the source. Once the contaminants are removed and destroyed the uncertainty is eliminated. Moreover, the uncertainty as to long-term effectiveness of the groundwater capture and treatment systems is also reduced by the elimination of contaminants at the source. If the magnitude of the sources of the migrating contaminants is reduced, then any future risk of their movement through or around the capture and treatment system is also reduced as is the time of operation of the trenches.

The HSC remedy would do considerably less than the EPA remedy to remove contaminants at the source and would allow their continued migration for an undetermined amount of time. By allowing contaminants to remain in place for a longer period, the HSC remedy is less effective over the long-term than either of the EPA remedies. This is shown through the compound uncertainties associated with the HSC alternative. The first of these is uncertain length of operation of the HSC alternative due to remaining contaminant sources. Added to this uncertainty are those of the ability to maintain the system over this length of time and the increased opportunity for contaminants to escape over this period.

## 7.4 Reduction of Volume, Toxicity or Mobility

CERCLA states, in section 121(a)(1), a clear preference for remedies which reduce the volume, toxicity, and mobility of waste. The EPA remedies would both reduce the mobility and volume of the contaminants through their removal and destruction at the source. The soil vapor extraction, moreover, would remove the most highly mobile volatile organic compounds from the soils of the source areas. The HSC remedy allows both greater mobility and volumes of waste since the HSC alternative would only recover the contaminants that enter the two HSC interceptor trenches. Waiting for the wastes to migrate to the trenches allows for a greater volume of contaminated material as the contamination spreads to greater amounts of groundwater and soils as it migrates. The mobility of the wastes is also greater in the HSC remedy than in the EPA remedies as it allows the wastes to migrate and become more dilute rather than taking the more efficient approach of capturing them and destroying them in concentrated form in the source areas.

The treatment of source areas with soil vapor extraction would remove a large portion of the carcinogenic compounds in those areas and destroy them thereby reducing the toxicity of the contaminants rapidly. Again, the HSC relies on all contaminants to enter their collection systems. As for volume of contaminants, the EPA remedies, by eliminating contamination at the source, would directly reduce contamination through the recovery and destruction of contaminants and would reduce the future volume of contaminated material by eliminating the migration of these (contaminants and their subsequent contamination of soil and groundwater as they spread). The HSC remedy would allow the migration of contaminants out of the source areas not only further contaminating the groundwater and soils between the source areas and the collection trenches, but increasing the potential for the escape of contamination both vertically and horizontally either under or around the control systems.

## 7.5 Short-term Effectiveness

The short-term effectiveness for the HSC remedy would be higher than that for either EPA remedy as, since nothing would be done about the contamination at the source, there would be none of the attendant risks of taking action. It should be noted, however, that the short-term risks of taking action can be addressed through use of appropriate safety and engineering methods.

Both EPA remedies pose certain short-term risks. If the drums in source areas are excavated, then the soils around the drums will be disturbed and exposed to air. This creates an opportunity for volatilization of contaminants. The risks associated with excavation and lancing of drums have been examined. The risks to onsite workers are related to the excavation and handling of the waste drums and the surrounding materials. Drum excavation has been successfully implemented at a number of hazardous waste sites (see Table 7-2) and the effects are known. Exposure of site workers to hazardous substances and situations during the implementation of either EPA remedy can be minimized or prevented with well-planned and implemented personnel training programs, the supply and utilization of the appropriate safety and personal protection equipment and the development and use of an effective site safety plan.

The risk to individuals offsite has also been examined. The primary risk to those offsite comes from release of volatile chemicals or contaminated dust from the site. This contamination could reach individuals through two primary pathways, inhalation of volatile chemicals or consumption of beef and milk from livestock maintained in the area. The total extra lifetime human cancer risk from ingestion of beef and milk is estimated to be seven in ten million. This also assumes, conservatively, that the ten million individuals exposed obtain 100% of their beef and milk from the effected area. More realistic estimates of exposure and ingestion would reduce the seven extra cancer risk in ten million exposures even further.

SELECTED HAZARDOUS WASTE SITE HISTORIES - DRUM REMOVALS

TABLE 7-2

| SITE NAME/ LOCATION | SOURCE OF INFORMATION | NUMBER OF DRUMS REMOVED | DATE DRUMS REMOVED | RELEVANT COMMENTS |
|---|---|---|---|---|
| Demode Site<br>Rose Township<br>MI | Paul Gauthier<br>OSC<br>Michigan DNR<br>(517) 373-8427 | 4,500 | 1979-80 | No reported accidents to onsite workers.<br>Drums contained PCB & other wastes. |
| Springfield Township<br>MI | Paul Gauthier<br>OSC<br>Michigan DNR<br>(517) 373-8427 | 1,500 | 1979-80 | No reported accidents to onsite workers.<br>Drums contained PCB & other wastes. |
| Gilson Rd./Sylvester/<br>Nashua Site<br>NH | Chet Janowski<br>RPM<br>Region 1<br>(617) 573-9623 | 1,300 | 1980 | No reported accidents to onsite workers.<br>Drums removed from surface of site. |
| Piccolo Farm<br>RI | EPA Record of Decision | 30,000 | 1980 | Drums contained PCB's and VOC's. |
| Goose Farm<br>NJ | EPA Record of Decision | 5,000 | 1980 | Drums 10 to 40 years old. |
| Enterprise Ave<br>Philadelphia<br>PA | EPA Record of Decision, and<br>Walt Graham, RPM<br>EPA Region 3<br>(215) 597-2193 | 1,700 | 1982 | No reported incidents.<br>Age of drums estimated at 10 to 20 years. Mostly solvents, rosins & resins. Site removed from NPL. |
| Taylor Burrough<br>Scranton<br>PA | Pat Tan<br>RPM<br>EPA Region 3<br>(215) 597-3164 | 1,200 | 1983 | No reported accidents to onsite workers.<br>Drums were removed from site surface only. Half were empty. |
| Tower Chemical<br>Lake City<br>FL | EPA Record of Decision | 72 | 1983 | Drums 2 to 32 years old. |

## SELECTED HAZARDOUS WASTE SITE HISTORIES - DRUM REMOVALS

TABLE 7-2 (continued)

| SITE NAME/ LOCATION | SOURCE OF INFORMATION | NUMBER OF DRUMS REMOVED | DATE DRUMS REMOVED | RELEVANT COMMENTS |
|---|---|---|---|---|
| Cleve Reber<br>LA | EPA Record of Decision | 1,100 | 1983 | More drums on site to be removed. |
| Berlin Farro<br>MI | Pete Ollila<br>Michigan DNR<br>(517)373-8174 | 20,000+ | 1984 | No reported accidents to onsite workers.<br>Drums excavated up to 22 ft. Says drums have been removed at over 300 sited in MI. |
| Byron/Johnson Salvage<br>Byron, IL | Bill Bolen<br>RPM<br>EPA Region 5<br>(312) 353-6316 | 100's | 1985 | No accidents.<br>Drums excavated and removed. Used bulldozer to remove them from surface & ravines. |
| Aberdeen Pesticide Dump<br>Aberdeen<br>SC | Ned Jessup<br>OSC<br>EPA Region 4<br>(404) 347-3931 | 687 | 1986-87 | No accidents or injuries.<br>Excavated to 10 ft.. Most drums empty when removed. |
| Denver-Arapahoe Chem Waste Mgmt Facility<br>CO | EPA Record of Decision | 30,000 | 1986-87 | Drums 8 to 10 years old. |
| Bioecology<br>Dallas<br>TX | Steve Veale<br>RPM<br>EPA Region 6<br>(214) 655-6715 | 3,000 (est.) | 1987-88 | No accidents related to drum removal operations.<br>Level B & C. Excavated 85,000 cu. yards soil & debris including buried drums (drums approx. 1 % of waste). |
| Lackawanna Refuse Site<br>Lackawanna City<br>PA | Walter Graham<br>RPM<br>EPA Region 3<br>(215) 597-2193 | 8,000 | 1988 | No reported accidents to onsite workers.<br>Drums removed from stripmine landfill. None intact.<br>Excavated 30-35 ft. deep over 5 acre area. |
| Zieman Grames Landfill<br>Monroe County<br>MI | Ross Powers<br>OSC<br>EPA Region 5<br>(313) 675-3178 | 2,200 | 1988 | No reported accidents to onsite workers.<br>Slow work. Level B. Excavated to 6 ft. with bulldozer & grappler. |

SELECTED HAZARDOUS WASTE SITE HISTORIES - DRUM REMOVALS

TABLE 7-2 (continued)

| SITE NAME/ LOCATION | SOURCE OF INFORMATION | NUMBER OF DRUMS REMOVED | DATE DRUMS REMOVED | RELEVANT COMMENTS |
|---|---|---|---|---|
| Syntex Landfill Lyons, CO | Gary Kaufman Env. Engineer Syntex (303) 938-6430 & Mark Davis CO Geol. Survey (303) 866-2611 | 15,000 | 1988 | No reported accidents to onsite workers. USPCI excavated 28,000 tons of contaminated soil and 15,000 drums of contaminated wastes which were sent off-site for disposal and treatment. Drums 10 to 20 years old or older. |
| Great Lakes Container MI | Paul Gauthier OSC Michigan DNR (517) 373-8427 | 750+ | on-going | No reported accidents to onsite workers. Shallow operation (1 to 2 ft.). |
| D'Imperio Drum Dump Atlantic City NJ | Ramona Pezzella RPM Region 2 (212) 264-8216 | 130 (est.) | 1986-87 | No reported accidents to onsite workers. Excavated 3900 cu. yards of soil & drums. |
| Auburn Rd. Landfill NH | Don Burger OSC, Region 1 (617) 860-4360 | to be provided | | Major drum excavation close to residential area. Buried 8 to 10 ft.. |
| Ottati Goss NH | Don Burger OSC, Region 1 (617) 860-4360 | to be provided | | Drums excavated under U.S. EPA Emergency Response Cleanup Services Contract (ERCS). |
| Davis Liquid RI | Don Burger OSC, Region 1 (617) 860-4360 | to be provided | | Drums excavated under ERCS. |
| Blosinski Landfill PA | Walter Graham RPM EPA Region 3 (215) 597-2193 | 50-60 | 1982 | No reported accidents to onsite workers. Only surface drums & a tank truck were removed. |

The total extra lifetime human cancer risk from inhalation of chemicals released during excavation of the Barrel Mound and part of the Main Pit is estimated to be one in ten million. The estimated risk from operating of the SVE system is six in ten billion.

The opportunity for volatilization can be reduced through using the smallest possible working face and thereby limiting the contaminated materials exposed to the air. Common sense precautions such as excavating during cooler weather will also reduce volatilization. The use of volatilization control techniques such as foam supressants can also be used.

Other short-term risks were also considered. The intermingling of the drummed liquids can be limited through the segregation of the drum contents as they are removed. The short-term risks associated with the drum lancing proposal include those associated with the physical puncturing of the drums and of the mixing of the liquids after they are released by the lancing. The risks of lancing can be reduced through the use of controlled lancing. The work would proceed gradually with the removal of liquids released as rapidly as feasible during the lancing. The lancing work could also be done by remote control to protect site workers. The risks of puncturing the drums could be reduced through the use of non-sparking materials on the lance points and through the use of carbon dioxide to eliminate the oxygen supply through the lance hole if needed. It is important to note that there is already extensive mixing of the source area liquids as evidenced by the amount of pooled liquids in the Barrel Mound. This would indicate that the risks from further mixing are less than might otherwise be anticipated.

Of these two alternatives, excavation poses less of a short-term risk. It allows greater control and observation of the hazardous materials that are disturbed.

7.6 Implementability

The majority of all three alternatives use established technologies and could be implemented. Only the lancing of drums has not been attempted at a hazardous waste site. The lancing technique has been demonstrated for the puncturing of buried drums and has been used for other industrial purposes. This one point leads to a slight preference for the EPA excavation alternative and the HSC proposal over lancing for this criteria.

7.7 Cost

Because it is a less extensive remedy, the HSC remedy is cheaper than either of the EPA remedies. It is important to remember that the HSC proposal is not an equally protective remedy when compared to the two EPA proposals. The relative estimated costs for the three alternatives are: HSC $46 million, EPA with excavation $63 million, and EPA with lancing $59 million. An additional consideration is costs associated with remedy failure.

With greater amounts of waste remaining in the source areas for a longer period under the HSC remedy, the potential exists for greater costs should additional remedial work be required.

### 7.8 State and Community Acceptance

State comment on the proposed plan for remedial action can be found in the transcript for the public meeting held on October 26, 1989 and in their letter of November 13, 1989. Basically the Oklahoma State Department of Health as representative of the State of Oklahoma supports elements of EPA's selected remedy including soil vapor extraction, but disagrees with with the excavation or lancing of the drums in the source areas, and with the use of catalytic oxidation as a thermal treatment.

Public comment expressed at the public meeting showed a preference for quicker action and for more permanent remediation. To quote one of the local residents who spoke at the public meeting,

> "... Personally, I think that the way that some of the basic ideas that you have got about addressing the cleanup of this is good. I particularly like the idea of removing the drums. When you start taking these materials out, when you remove them from the site completely, it's the only way that you are going to create any kind of confidence that you have really cleaned it up."

## SECTION 8: THE SELECTED REMEDY

Based upon consideration of the requirements of CERCLA as specified in Section 7.0 of this document, the detailed analysis of the alternatives, and State and public comments, EPA has determined that the Partially Revised EPA Remedy involving the excavation of drums for liquids removal, is the most appropriate remedy for the Hardage/Criner site near Criner, Oklahoma. A schematic of the selected remedy is shown in Figure 8-1.

The first element of the selected remedy is the removal and destruction of contaminants in the source areas. Free liquids within the three major source areas, the Barrel Mound, Sludge Mound and Main Pit, would be removed through extraction wells. Organic liquids would be transported offsite for destruction and aqueous liquids treated onsite. Drum concentrations in the Barrel Mound and Main Pit would be excavated. Liquids in the drums would be removed and taken offsite for destruction. Solids would be restored to the three main source areas. Contamination from adjacent areas would be consolidated into the three main source areas. These source areas would be treated through soil vapor extraction (SVE) to remove contaminants. The resulting SVE effluent contaminants would be destroyed onsite using thermal treatment. It is this element of the recovery and destruction of the contamination at its source that is missing from the HSC remedy and which confers the greatest degree of superiority to the selected remedy over that recommended by the HSC. The reduction in the long-term uncertainties associated with leaving large portions of the source areas of contamination unremediated, as in the HSC alternative, is another area in which the superiority of the selected remedy over the HSC alternative is demonstrated.

The second element of the selected remedy would be control of residual contamination. The major source areas would be capped first temporarily during treatment and removal in the source areas, and then permanently with a regulatorily compliant cap following completion of the main treatment and removal phase. Groundwater would be collected through interceptor trenches and treated onsite. Surface water controls would be instituted to minimize contaminated runoff.

Finally, institutional controls would be implemented to prevent use of contaminated groundwater downgradient of the source areas. Alternate water supplies would be continued to replace supplies lost through contamination. The site boundaries would be expanded from the original site to the area indicated in Figure 4-6 to facilitate the implementation of the institutional controls.

The estimated cost for the selected remedy is $63 million. Table 8-1 gives a breakdown of this estimate and a detailed cost estimate can be found in Appendix G.

### 8.1 Remediation Goals

The purpose of this action is to protect human health and the environment through control of risks posed by the Hardage/Criner site and minimizing further migration of the site contaminants. Estimates of the risk of cancer from lifetime use of residential water contaminated at the level of the Old Corley well range as high as 0.0007 (seven per ten thousand) to 0.006 (six per thousand) far above the one per hundred thousand risk which is the upper

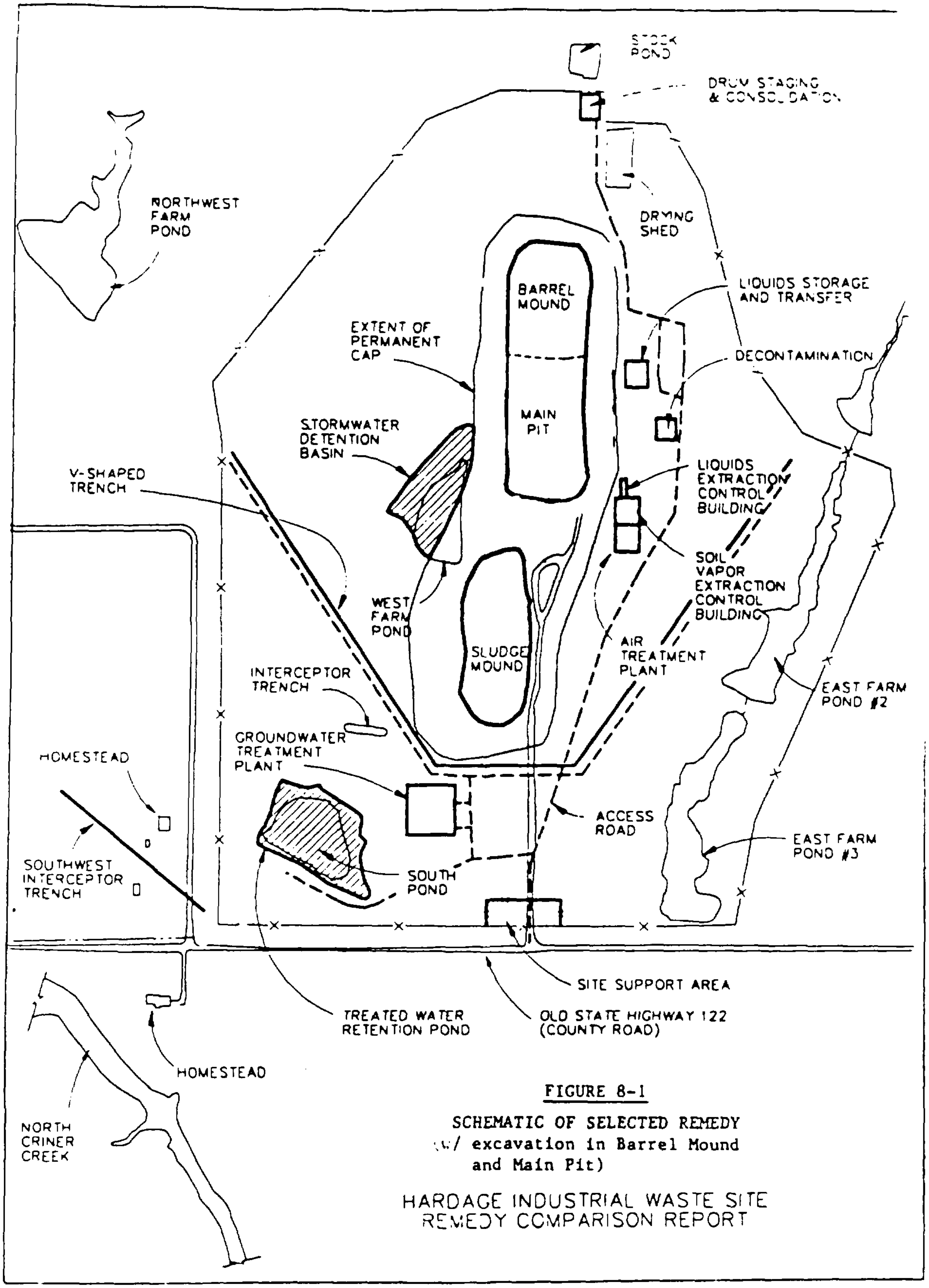


**FIGURE 8-1**

**SCHEMATIC OF SELECTED REMEDY (w/ excavation in Barrel Mound and Main Pit)**

HARDAGE INDUSTRIAL WASTE SITE
REMEDY COMPARISON REPORT

TABLE 8-1

COST SUMMARY FOR THE SELECTED REMEDY[1]

| | |
|---|---|
| Liquids Removal and Control | $ 6,449,745 |
| Drummed Waste Staging/Consolidation Area and Storage | 2,813,516 |
| Soil Vapor Extraction and Treatment | 3,098,052 |
| Removal of Adjacent Wastes | 2,168,834 |
| Source Area Capping | 3,722,605 |
| Ground Water Extraction and Treatment | 5,971,286 |
| Remedy Support Facilities | 3,237,290 |
| Surface Water Controls | 196,000 |
| Remedial Monitoring | 41,250 |
| Institutional controls | 608,250 |
| | $28,306,837 |
| Bid and Scope Contingency | 9,907,393 |
| Implementation Costs | 10,317,842 |
| Conversion to September 1989 dollars | |
| Operation and Maintenance for 30 Years | 14,309,500 |
| TOTAL | $62,904,655 |

1 Source: Remedy Report for the Hardage Industrial Waste Site, Criner, Oklahoma, October 13, 1989.

boundary of acceptable risk set in the National Contingency Plan.

To accomplish this goal, the remedy would permanently and significantly reduce the volume, toxicity, and mobility of contaminants in the source areas. This is accomplished through removal of liquid contaminants quickly and directly through liquid extraction wells and excavation of drum liquids. By following these steps with soil vapor extraction, removal and destruction of the most mobile contaminants, including most of the known and suspected human carcinogens, will be acheived. The goal of soil vapor extraction would be a 99% reduction of the volatile organic concentrations found at the beginning of soil vapor extraction.

Beyond reduction of the source, the goal of this action is to restore the groundwater to levels below MCLs. This action is particularly directed at the alluvial aquifer assoicated with North Criner Creek.

The superiority of the selected remedy is demonstrated in the comparison of the alternatives through the use of the nine criteria given in Section 7 of this document. The reduction in the sources of the contamination associated with the selected remedy confers advantage to the selected remedy over the remedy recommended by the HSC. By eliminating the contaminants at their source the selected remedy is more protective of human health and the environment, has greater long-term effectiveness and permanence and provides for greater reduction in the volume, toxicity and mobility of contaminants than provided by the HSC remedy. The selected remedy can be implemented using existing technologies and methods. Its cost is greater than that of the HSC proposal, but the selected remedy through its source control elements provides greater and more efficient levels of remediation. In this regard, the additional costs associated with the selected remedy are reasonable. The selected remedy would also comply with existing ARARs on cap construction, which the HSC alternative would not do, and would attain the standards for drinking water quality in the alluvial aquifer as expressed through the Safe Drinking Water Act MCLs in a shorter period of time than the HSC proposal would. The State of Oklahoma through its representatives has expressed concerns about the short-term effectiveness of the selected alternative, and some short-term risks do exist. However, these risks have been considered, and they can be controlled or eliminated through the application of prudent engineering and safety techniques. Finally, the local community, through the public comment period on the alternatives expressed a preference for removal and destruction of as great an amount of the contamination as possible from the source areas. The selected remedy provides for far greater direct removal of the source area contaminants than does the HSC proposal.

The selected remedy also holds advantage over the other EPA alternative which included lancing. The lancing techniques have not been used at a hazardous waste site before and therefore their implementability is not as well known as the excavation of drums in the selected remedy. There are also greater uncertainties associated with in-place release of the drummed liquids through lancing that will not exist with the selected excavation program with actual physical removal of the drummed liquids.

## 9.0 STATUTORY DETERMINATIONS

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for this site must comply with applicable or relevant and appropriate environmental laws unless a statutory waiver is justified. The selected remedy also must be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute expresses a preference for remedies which significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

### 9.1 Protection of Human Health and the Environment

The remedy seeks remove liquid contaminants quickly and directly through liquid extraction wells and excavation of drum concentrations. By following this removal with soil vapor extraction, removal and destruction of the most mobile contaminants including most of the known and suspected human carcinogens will be acheived.

Along with effective reduction of contaminant sources, the selected remedy protects human health and the environment through intercepting and treating contaminated groundwater with interceptor trenches. The North Criner Creek alluvial aquifer is the nearest groundwater used as a residential water source. The selected remedy provides better protection of human health and the environment as it will achieve the goals for groundwater cleanup more quickly than the HSC proposal. The selected remedy will eliminate uncertainties associated with the continued presence of toxic and mobile volatile contaminants in the source areas by recovering and eliminating contaminants, unlike the HSC alternative which would allow these contaminants to migrate.

9.2 Compliance with Applicable or Relevant and Appropriate Requirements

The elements of the selected remedy would all comply with applicable or relevant and appropriate requirements (ARARs) established for this site. A more complete examination of ARARs can be found in Appendix A. Key among these ARARs are the Safe Drinking Water Act chemical specific requirements known as MCLs (maximum contaminant limits), and the requirements under the Resource Conservation and Recovery Act (RCRA) which relate to the construction of hazardous waste facilities and their closure.

ARARs include:

1) RCRA requirements for landfill closure in 40 CFR 264.111 Subpart G and 264.310 Subpart N which specify cap requirements for landfills;

2) RCRA requirements in 40 CFR 264.117 Subpart G dealing with Post-closure;

3) Requirements under State of Oklahoma Air Regulations requiring use of Best Developed Available Control Technology for treatment of the air from the SVE system.

4) Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act;

5) State of Oklahoma maximum acceptable ambient concentrations (MAACs) for air contaminants;

6) Oklahoma Water Quality Standards for discharge to a surface stream.

None of the alternatives would result in rapid restoration of the ground-water within the site to MCLs. However, the selected remedy would accomplish this goal more rapidly than the HSC remedy through the elimination of contaminant sources. The selected remedy would also meet RCRA requirements for the construction of the cap over the source areas; the proposed HSC alternative does not meet these requirements.

9.3 Cost Effectiveness

The selected remedy is cost effective and would cost an estimated 63 million dollars. It includes some 20 million dollars of cost directly related to contaminant source area reductions, through excavation, soil vapor extraction, and liquids extraction. The HSC remedy does not include these costs. This additonal cost is reasonable considering the added long-term protection of human health the environment provided by direct and permanent reductions to the source areas.

9.4 Utilization of Permanent Solutions and Alternative Treatment Technologies.

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost effective manner. The amendment of the 1986 ROD, which called for land filling and stabilizing the source soils and sludges, to the new selected remedy of excavation, liquid extraction, soil vapor extraction and capping provides for a permanent solution through additional recovery and treatment of contaminants.

The emphasis in the selected remedy is on the recovery and permanent destruction of the contaminants at the source. This begins with the recovery of the free liquids and the liquids in the buried drums through excavation and liquid extraction, and the subsequent destruction and treatment of these liquids offsite in a permitted Treatment, Storage, and Disposal facility and in the onsite water treatment system. It also includes soil vapor extraction of the Main Pit, Barrel Mound and Sludge Mound to remove volatile organic compounds.

Another aspect of permanence is the reduction of the mobility, toxicity or volume of the wastes. The selected remedy accomplishes all of these goals through removal of contaminants at the source, unlike the HSC alternative which would allow contaminants to migrate out of the source areas.

Through removal and destruction of contaminants by SVE the amended selected remedy provides permanence, particularly when combined with the groundwater collection and treatment elements of the selected remedy. The groundwater portions of the selected remedy utilize permanent solutions through removal and treatment of contaminated groundwater and the destruction of the organic contaminants removed during treatment.

9.5 Preference for Treatment as a Principal Element

Treatment is central to the selected remedy. Treatment is used extensively to address each of the three primary contaminated media. Free organic liquids from the source areas and organic liquids from the excavated drums will be taken offsite for destruction or treatment at an appropriate, permitted Treatment, Storage and Disposal facility. Contaminated soils and sludges that remain following liquids removal and treatment will be consolidated into the three main source areas for treatment with a soil vapor extraction (SVE) system. The goal of the SVE system will be removal of 99% of the volatile organic contaminants from the contaminated soils and sludges. The air from the soil vapor extraction system, and air effluent streams from other remedy components, will be treated onsite with a thermal treatment system, to treat and destroy the contaminants within the air streams. The third major contaminated media is the aqueous liquids including groundwater, aqueous liquids from the buried drums, and surface run-off. All of these liquids will be treated in an an onsite water treatment plant. The water treatment plant will be designed to treat the influent liquids to standards for discharge in accordance with Oklahoma Water Quality Standards.

Additional advantages in the treatment in the selected remedy are gained by treatment of the contaminants in a more concentrated form. This is true of the free and contained liquids in the source areas due to the liquid extraction wells and collection of the free liquids and the excavation of the buried drums. The SVE system will also recover the volatile contaminants from the soils and sludges in the three source areas allowing them to be treated in a concentrated air stream rather than diffused through the soils and sludges. Treatment of the contaminants at their source will also improve the effectiveness of the water treatment system through reduction of contaminant migration to groundwater. The contaminants will be treated before they migrate into the groundwater where they would spread and be diluted.

## 9.6 Documentation of Significant Changes

The Proposed Plan for the Hardage/Criner site was released for public comment on October 13, 1989. The Proposed Plan identified the use of drum lancing as an option for addressing the buried drums. Comments received during the public comment period indicated particularly strong opposition from the State of Oklahoma to retention of this option. While EPA feels that drum lancing could be implemented, the option of drum lancing and associated U-shaped trench has been deleted from the selected remedy and only excavation is part of the selected remedy.

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APPENDIX A

EVALUATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

## INITIAL SCREENING OF POTENTIAL FEDERAL CHEMICAL-SPECIFIC ARAR'S

| Requirement | Prerequisites | Citation | Description | Applicable/Relevant and Appropriate | Comments |
|---|---|---|---|---|---|
| Safe Drinking Water Act (SDWA) | | (42 USC 300f) | | | |
| National Primary Drinking Water Standards | Public Water System | 40 CFR 141 | Establishes health-based standards for public water systems (maximum contaminant levels (MCLs)). | Yes/-- | Organic and inorganic contaminants have been detected at the study area. |
| National Secondary Drinking Water Standards | Public Water System | 40 CFR 143 | Establishes standards for the aesthetic qualities of public water systems (secondary MCLs (SMCLs)). | No/Yes | SMCLs are not federally enforceable but are intended as guidelines for the states. |
| Maximum Contaminant Level Goals | Public Water System | Public Law No. 99-339 100 Stat. 642 (1986) | Establishes maximum contaminant level goals (MCLGs) of no known or anticipated adverse health effects. | No/No | MCLGs are non enforceable requirements. |
| Clean Water Act (CWA) | Waters of the United States | 33 USC 1251-1376 | Objectives are to restore and maintain the chemical, physical, and biological integrity of the nation's waters. | yes/ | Specific requirements are listed under discharge requirements |
| Water Quality Criteria | | 40 CFR 131 | | | |
| Clean Air Act (CAA) | | | | | |
| National Primary and Secondary Ambient Air Quality Standards | Contamination of air affecting public health and welfare | 40 CFR 50 (42 USC 7401-7642) | Establishes standards for ambient air quality to protect public health and welfare (including standards for particulate matter and lead). | No/Yes | Air effluent from the treatment systems must meet these standards. |
| Resource Conservation and Recovery Act (RCRA) | Uppermost aquifer underlying a waste management unit beyond the point of compliance | 40 CFR 264.94 | Owners/operators of RCRA treatment, storage, or disposal facilities must comply with conditions in the facility permit that are designed to ensure that hazardous constituents entering the groundwater from a regulated unit do not exceed the concentration limits under 264.94 in the uppermost aquifer underlying the waste management area beyond the point of compliance. | Yes/-- | The specific properties of the site may be similar enough to these requirements to render them relevant and appropriate. |

Note -- = If a requirement is applicable, it cannot also be relevant and appropriate.

SPR15W1-1

INITIAL SCREENING OF POTENTIAL FEDERAL LOCATION-SPECIFIC ARAR'S

| Requirement | Prerequisites | Citation | Description | Applicable/Relevant and Appropriate | Comments |
|---|---|---|---|---|---|
| Resource Conservation and Recovery Act (RCRA) | RCRA hazardous waste, treatment, storage, or disposal | 40 CFR 264.18(a) | New treatment, storage, or disposal of hazardous waste prohibited within 61 meters of a fault displaced in Holocene time. | No/No | There are no known faults within 61 meters. |
| RCRA | RCRA hazardous waste, treatment, storage, or disposal | 40 CFR 264.18(b) | Treatment, storage, or disposal facilities within the 100-year flood plain must be designed, constructed, operated, and maintained to prevent washout. | yes/-- | Part of the site lies within the 100-year flood plain. |
| Executive Order on Flood Plains | Action that will occur in a flood plain (i.e., lowlands and relatively flat areas adjoining inland and coastal waters, and other flood-prone areas) | Executive Order 11988 | Must take action to avoid or minimize potential harm to flood plains, and restore and preserve natural and beneficial values. | yes/-- | Part of the site lies within the 100-year flood plain. |
| RCRA | Noncontainerized or bulk liquid hazardous waste | 40 CFR 264.18(c) | The placement of any noncontainerized or bulk liquid hazardous waste in a salt dome formation, salt bed formation, underground mine, or cave is prohibited. | No/No | There are no salt dome formations, salt bed formations, underground mines, or caves onsite. Disposal in salt dome formations, mines, or caves is not contemplated for this project. |
| National Archaeological and Historical Preservation Act | Alteration of terrain that threatens significant scientific, prehistorical, historical, or archaeological data | (16 USC Section 469) 36 CFR 65 | Must take action to recover and preserve artifacts. | No/No | There are no known scientific, prehistoric, historic, or archaeological artifacts onsite. |
| Fish and Wildlife Coordination Act | Diversion channeling or other activity that modifies a stream or river and affects fish or wildlife | (16 USC 661 et. seq.) 40 CFR 6.302 | Must take action to protect fish or wildlife | yes/-- | Discharge to North Criner Creek is planned as part of the remediation |
| Scenic Rivers Act | Activities that affect or may affect any of the rivers specified in Section 1276(a) | (16 USC 1271 et. seq. Section 7(a)) 40 CFR 6.302(e) | Must avoid taking or assisting in action that will have direct adverse effect on scenic river. | No/No | No action planned at the site will have direct adverse effect on a scenic river. |

Note: -- = If a requirement is applicable, it cannot also be relevant and appropriate.

SFR159/1-2

(Continued)

| Requirement | Prerequisites | Citation | Description | Applicable/Relevant and Appropriate | Comments |
|---|---|---|---|---|---|
| Coastal Zone Management Act | Activities affecting the coastal zone including lands thereunder and adjacent shorelands | (16 USC Section 1451 et. seq.) | Must conduct activities in a manner consistent with approved state management programs. | No/No | The study area is an inland site with no direct access to coastal lands. |
| Clean Water Act (CWA) Section 404 | Oceans and waters of the United States | 40 CFR, Subpart H | Action to dispose of dredge material into ocean waters is prohibited without a permit. | No/No | No action to dredge material is proposed at the site. |
| Marine Protection Resources and Sanctuary Act, Section 103 | Oceans and waters of the United States | (33 USC 1251-1376) 40 CFR 230, 231 | Action to dispose of dredge material into ocean waters is prohibited without a permit | No/No | No action to dredge material is proposed at the site. |
| Historic Sites, Buildings, and Antiquities Act | Existence of natural landmarks | (16 USC 461-467) | Must avoid undesirable impacts upon landmarks. | No/No | There are no landmarks on the National Register of Natural Landmarks on the site. |
| Rivers and Harbors Act | Activities affecting navigation waters | (33 CFR 320-330) 33 USC 403 | Substative requirements of Section 10 must be met if an alternative developed would involve structures or work in or affect navigable waters. | No/Yes | No structure or work in surface stream is planned other than monitoring. |
| National Historic Preservation Act, Section 106 | Property included in or eligible for the National Register for Historic Places | (16 USC 470 et. seq.) 36 CFR 800 | Must take action to preserve historic properties owned or controlled by federal agency. Must plan action to minimize harm to National Historic landmarks. | No/No | The site is not included in or eligible for the National Register of Historic Places. |
| Endangered Species Act of 1973 | Critical habitat upon which endangered species or threatened species depends | (16 USC 1531 et. seq.) 50 CFR 200, 50 CFR 402 | Must take action to conserve endangered species or threatened species. | No/No | The site is not a critical habitat upon which endangered species or threatened species depend. |
| Executive Order on Protection of Wetlands | Wetland as defined by Executive Order 11990, Section 7 | Executive Order 11990 40 CFR Appendix 6 | Must take action to minimize the destruction, loss, or degradation of wetlands. | No/No | The site is not a wetland as defined by Executive Order 11990, Section 7. |

Note: -- If a requirement is applicable, it cannot also be relevant and appropriate.

STP159/1-3

(continued)

| Requirement | Prerequisites | Citation | Description | Applicable/Relevant and Appropriate | Comments |
|---|---|---|---|---|---|
| Wilderness Act | Federally owned area described as a wilderness area | 50 CFR 35.1 *et. seq.* | Area must be administered in such a manner that will leave it unimpaired as wilderness and to preserve its wilderness character. | No/No | The site is not a federally owned area described as a wilderness area. |
| National Wildlife Refuge System | Area designated as part of the National Wildlife Refuge System | 50 CFR Part 27, (16 USC 668 d.d. *et. seq.*) | Only actions that are allowed under the provisions of 16 USC, Section dd(c) may be undertaken in areas that are part of the National Wildlife Refuge System. | No/No | The site is not designated as part of the National Wildlife Refuge System |

Note: -- • If a requirement is applicable, it cannot also be relevant and appropriate.

INITIAL SCREENING OF POTENTIAL FEDERAL ACTION-SPECIFIC ARARs

| Requirement | Prerequisites | Citation | Description | Applicable/Relevant and Appropriate | Comments |
|---|---|---|---|---|---|
| Solid Waste Disposal Act | | (42 USC 6901-6987) | | | |
| Criteria for Classification of Solid Waste Disposal Facilities and Practices | Disposal of solid waste | 40 CFR 257 | Establishes criteria for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment and, thereby, constitute prohibited open dumps. | No/Yes | However, the more stringent provisions of 40 CFR 260 supersede these criteria. |
| Hazardous Waste Management System: General | RCRA hazardous waste | 40 CFR 260 | Establishes procedures and criteria for modification or revocation of any provision in 40 CFR 260-265. | No/No | No modifications or revocations are needed; existing regulations will be used. |
| Identification and Listing of Hazardous Waste | Solid waste | 40 CFR 261 | Defines those solid wastes that are subject to regulation as hazardous wastes under 40 CFR 263-265, and 124, 270, and 271. | No/Yes | Are relevant and appropriate if any solid waste residues are generated as a result of treatment. |
| Standards Applicable to Generators of Hazardous Waste | Generation of RCRA hazardous waste | 40 CFR 262 | Establishes standards for generators of hazardous waste. | No/Yes | Are relevant and appropriate if there is hazardous solid or liquid residues from treatment plant. |
| Standards Applicable to Transporters of Hazardous Waste | Generation of RCRA hazard waste with offsite disposal | 40 CFR 263 | Establishes standards that apply to persons transporting hazardous waste within the U.S. if the transportation requires a manifest under 40 CFR 262. | Yes/-- | Applicable to off-site transport of recovered liquids or if there is hazardous residues from the treatment systems. |
| Standards Applicable to Owners/Operators of Hazardous Waste Treatment, Storage and Disposal Facilities | RCRA hazardous waste | 40 CFR 264 | Establishes minimum national standards that define the acceptable management of hazardous waste for owners and operators of facilities that treat, store, or dispose of hazardous waste. | Yes/-- | Applicable to treatment facility. |
| • General Facility Standards | Treatment, storage, or disposal of RCRA hazardous waste onsite | Subpart B | N/A | No/Yes | Are relevant and appropriate for onsite treatment facility. |
| • Preparedness and Prevention | Generation or treatment, storage, or disposal of RCRA hazardous waste onsite | Subpart C | N/A | No/Yes | Treatment facility needs a properly developed and implemented plan for worker safety. |
| • Contingency Plan and Emergency Procedures | Generation or treatment, storage, or disposal of RCRA hazardous waste onsite | Subpart D | N/A | No/Yes | Establishes normal safety plans and procedures. |
| • Manifest System Recordkeeping and Reporting | Generation or treatment, storage, or disposal of RCRA hazardous waste onsite | Subpart E | N/A | Yes/-- | Are applicable if hazardous solid and liquid residues from treatment plant must be transported offsite. |
| • Releases from Solid Waste Management Units | Generation or treatment, storage, or disposal of RCRA hazardous waste onsite | Subpart F | N/A | No/Yes | Groundwater monitoring provisions are relevant and appropriate. |
| • Closure and Post-Closure | Generation or treatment, storage, or disposal of RCRA hazardous waste onsite | Subpart G | N/A | Yes/-- | Portions of Subpart G that deal with post-closure activities are applicable. |

Note: -- = If a requirement is applicable, it cannot also be relevant and appropriate.

SPR159/001-1

(Continued)

| Requirement | Prerequisites | Citation | Description | Applicable/Relevant and Appropriate | Comments |
|---|---|---|---|---|---|
| • Financial Requirements | Generation or treatment, storage, or disposal of RCRA hazardous waste onsite | Subpart H | N/A | Yes/-- | |
| • Use and Management of Containers | Management of RCRA hazardous waste in containers | Subpart I | N/A | Yes/-- | Applicable for any containerized waste generated as a result of the [illegible] |
| • Tanks | Management of RCRA hazardous waste in tanks onsite | Subpart J | N/A | Yes/-- | Same as Subpart I. |
| • Surface Impoundments | Management of RCRA hazardous waste in surface impoundments onsite | Subpart K | N/A | Yes/-- | Applicable to surface impoundments constructed to hold hazardous waste. |
| • Waste Piles | Management of RCRA hazardous waste in waste piles onsite | Subpart L | N/A | No/No | Waste piles are not being used at this site. |
| • Land Treatment | Land treatment of RCRA hazardous waste onsite | Subpart M | N/A | No/No | Land treatment is not being proposed for use at this site. |
| • Landfills | Landfilling of RCRA hazardous waste onsite | Subpart N Part 264.310 | Establishes standards for hazardous waste landfills (including cap requirement) | Yes/-- | Closure of landfill |
| • Incinerators | Incineration of RCRA hazardous waste onsite | Subpart O | N/A | Yes/-- | The specific properties of the site may be similar enough to these requirements to render them relevant and appropriate. |
| • Miscellaneous Units | Treatment, storage, or disposal of miscellaneous units | Subpart X | | No/No | None are identified at this site. |
| Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities | | 40 CFR 265 | Establishes minimum national standards that define the acceptable management of hazardous waste during the period of interim status and until certification of final closure or, if the facility is subject to postclosure requirements, until postclosure responsibilities are fulfilled. | No/No | This is not an interim-status facility. |
| Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities | Recyclable materials that are reclaimed to recover precious metals | 40 CFR 266 | Establishes requirements that apply to recyclable materials that are reclaimed to recover economically significant amounts of precious metals. | No/No | This is not a recycling facility to recover precious metals. |
| Interim Standards for Owners and Operators of New Hazardous Waste Land Disposal Facilities | New RCRA hazardous waste land disposal facility | 40 CFR 267 | Establishes minimum national standards that define acceptable management of hazardous waste for new land disposal facilities. Also establishes standards for underground injection of hazardous wastes. | No/No | A new hazardous waste land disposal facility is not being proposed. Underground injection of hazardous wastes is not contemplated. |
| Land Disposal Restrictions | Land disposal of RCRA hazardous waste onsite or offsite | 40 CFR 268 | Prohibits land disposal of specified untreated hazardous wastes and provides special requirements for handling such wastes. | No/No | No untreated wastes are contemplated for disposal. |
| Hazardous Waste Permit Program | RCRA hazardous waste treatment, storage, and disposal onsite | 40 CFR 270 | Establishes provisions covering basic EPA permitting requirements. | No/No | Permits are not required for onsite activities at Superfund sites. |

Note: If a requirement is applicable, it cannot also be relevant and appropriate.

CF0150/011-3

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| Requirement | Prerequisites | Citation | Description | Applicable/Relevant and Appropriate | Comments |
|---|---|---|---|---|---|
| Underground Storage Tanks (UST) | Underground storage tank | 40 CFR 280 | Establishes regulations related to underground storage tanks. | No/No | There are no underground storage tanks that are being addressed in this study. |
| Proposed Regulation for Control of emissions of volatile organics | Volatile organics emissions | 52 FR 3748 | Proposed standard would require 95% reduction of volatile organic emissions from Product Accumulator Vessel. | Yes/-- | If a treatment plant is a product accumulator vessel. |
| Safe Drinking Water Act (SDWA) | | (42 USC 300g) | | | |
| Underground Injection Control Regulations (UIC) | Underground injection of substances | 40 CFR 144-147 | Provides for protection of underground sources of drinking water. | No/No | No injection of liquids is planned at the site. |
| Clean Water Act (CWA) | | 33 USC 1251-1376 | | | |
| National Pollutant Discharge Elimination System | Discharge of pollutants from any point source into waters of the United States | 40 CFR 122, 125 | Requires permits for the discharge of pollutants from any point source into waters of the United States. Permits based on ambient water quality criteria. | Yes/-- | Technology-based treatment requirements that are equivalent to best conventional control technology (BCT) or best available technology economically available (BAT) will be determined by EPA on a site-specific basis. |
| Effluent Limitations | Point source discharge into the Ore Mining and Dressing Point Source category | 40 CFR 440 | Sets technology-based effluent limitations for point source discharges in the Ore Mining and Dressing Point Source category. | No/No | No ore sources have been identified at the site. |
| National Pretreatment Standards | Pollutants that pass through or interfere with treatment processes in POTWs or that may contaminate sewage sludge. | 40 CFR 403 | Sets standards to control pollutants that pass through or interfere with treatment processes in POTWs or that may contaminate sewage sludge. | No/No | No discharge to a Public Sewage Treatment Plant is planned at the site. |
| Toxic Pollutant Effluent Standards | Aldrin/dieldrin, DDT, endrin, toxaphene, benzidene, PCBs | 40 CFR 129 | Establishes effluent standards or prohibitions for certain toxic pollutants. | Yes/-- | If these contaminants exist within the study area. |
| Marine Protection Research and Sanctuaries Act | Ocean dumping | (33 USC 1401-1445) | Regulates ocean dumping. | No/No | Ocean dumping not part of any proposed alternatives. |
| Toxic Substances Control Act (TSCA) | PCBs | (15 USC 2601-2629)<br>40 CFR 761 | Establishes storage and disposal requirements for PCBs. | Yes/-- | Applicable if PCBs are detected in materials being transported off-site or treated above action levels. |
| Surface Mining Control and Reclamation Act (SMCRA) | Mining operations | (30 USC 1201-1328) | Establishes provisions designed to protect the environment from the effects of surface coal mining operations and, to a lesser extent, noncoal mining. | No/No | Study area is not a mining-related site. |
| Clean Air Act (CAA) | | (42 USC 7401-7642) | | | |
| National Emission Standard for Hazardous Air Pollutants | Hazardous air pollutants | 40 CFR 61 | Sets emission standards for designated hazardous pollutants, including mercury, beryllium, and inorganic arsenic. | No/Yes | Some portions of 40 CFR 61 would be relevant and appropriate to off-gas emissions from the treatment systems. |

Note: -- = If a requirement is applicable, it cannot also be relevant and appropriate.

SPR155/001.1

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| Requirement | Prerequisites | Citation | Description | Applicable/Relevant and Appropriate | Comments |
|---|---|---|---|---|---|
| National Ambient Air Quality Criteria | Various air contaminants | | Sets emission standards for designated air contaminants to protect the public health and welfare. | Yes/-- | All proposed alternatives need to provide adequate level of worker protection during remediation. |
| New Source Performance Standards | New stationary source | | Sets emission standards for certain classes of new stationary sources of air pollution. | Yes/-- | If a certain class of new source is proposed as part of treatment plant. |
| Occupational Safety and Health Act (OSHA) | Remedial action workers | (29 USC 651-678) | Regulates worker health and safety. | Yes/-- | Applicable to worker health and safety. |
| Federal Mine Safety and Health Act | Work in underground mines | 30 USC 801-962 | Regulates working conditions in underground mines to assure safety and health of workers. | No/No | Study area is not a mining-related site. |
| Hazardous Materials Transportation Act | | (49 USC 1801-1813) | | | |
| Hazardous Materials Transportation Regulations | Transportation of hazardous materials | 49 CFR 107, 171-177 | Regulates transportation of hazardous materials. | Yes/-- | If any alternative requires the offsite transportation of hazardous materials. |

Note: -- = If a requirement is applicable, it cannot also be relevant and appropriate.

## Screening of State ARARS

| Requirement | Prerequisites | Citation | Description | Applicable/Relevant and Appropriate | Comments |
|---|---|---|---|---|---|
| Oklahoma Water Quality Standards (OWQS) | | 82 O.S. Supp. 1980 926 3, 926 6, 1085 2 | Promote & protect as many beneficial uses as are attainable and to assure that degradation of existing quality of waters does not occur. | yes/-- | Application depends on the designated beneficial use of the stream |
| Surface Water Quality Standards | | OWQS 300 | to provide that no waste be discharged into any waters of the State without first being given the degree of treatment necessary to protect the legitimate beneficial uses of such waters. | yes/-- | See specific requirements |
| Public & Private Water Supplies | Designated use by OWQS. | OWQS 300 5 | Criteria for water quality. | no/yes | Criner Creek is designated as a public & private water supply |
| Primary Warm Water Fishery | Designated use by OWQS. | OWQS 300 7 | Criteria to promote fish and wildlife propagation. | yes/-- | Both North Criner Creek and Criner Creek are designated for fish and wildlife propagation. |
| Agriculture | Designated use by OWQS. | OWQS 300 8 | Surface waters maintained so that toxicity does not inhibit continued ingestion by livestock or irrigation of crops. | yes/-- | Both Criner Creek and North Criner Creek are designated for beneficial use by agriculture. |
| M & I Process Water | Designated use by OWQS | OWQS 300.10 | Quality criteria for water used for process or cooling purposes. | yes/-- | Both Criner Creek and North Criner Creek are designated for use as M&I process water. |
| Primary Recreation and Secondary Recreation | Designated use by OWQS | OWQS 300 11 | Water shall not contain substances in concentrations that are irritating to skin or are toxic or cause illness upon ingestion | yes/-- | North Criner Creek is designated for secondary body contact recreation and Criner Creek for primary recreation. |
| Aesthetics | Designated use by OWQS | OWQS 300.14 | Surface Waters are to be aesthetically enjoyable | yes/-- | Both Criner Creek and North Criner Creek are affected by aesthetic standards. |
| Groundwater Quality Standards | | OWQS 400 | | | |
| Protective Measures | Fresh groundwater | OWQS 400.2 | Protective criteria for ground water | no/no | Not a major ground water basin |
| Oklahoma Clean Air Act | | 63 O.S. Supp. 1981 1-1801 et seq. | | | |
| Control of Emission of Hazardous and Toxic Air Contaminants | | Regulation 3.8 | Control of emissions of hazardous and toxic contaminants. | yes/-- | New source of hazardous or toxic air... |
| Control of Fugitive Dust | | Regulation 3.1 | Control visible emissions and particulates. | yes/-- | |
| Control of smoke, visible emissions and particulates. | | Regulation 3.1 | Take reasonable precautions to minimize atmospheric pollution. | yes/-- | |

APPENDIX B

AGENCY FOR TOXIC SUBSTANCES DISEASE
REGRISTRY EVALUATION

# Health Assessment for

ROYAL HARDAGE INDUSTRIAL HAZARDOUS WASTE LAND DISPOSAL FACILITY

CRINER, OKLAHOMA

DECEMBER 1988

SUMMARY

The Royal Hardage Industrial Hazardous Waste Land Disposal Facility (Hardage/Criner) National Priorities List (NPL) Site is located in Criner, McClain County, Oklahoma. The site is located in an agricultural area. There are volatile organic compounds (VOC's) and several heavy metals present in the groundwater and soil, and VOC's in surface water and sediment. The Record of Decision (ROD) for the first operable unit (source control) signed November 1986, selected several remedial actions which included excavation of the primary source material and separation of the wastes for treatment: solids to be disposed of in an on-site landfill which meets Resource Conservation and Recovery Act (RCRA) requirements, organic liquids to be incinerated, and inorganic liquids to be treated by other means as necessary. This site is currently in the remedial design phase.

## BACKGROUND

### A. SITE DESCRIPTION

The Hardage/Criner NPL Site is located in McClain County, Oklahoma, on 60 acres. Operations began at the facility in 1972. Several pits were excavated in the early years to receive wastes from barrels and tank trucks. The pits filled rapidly. The wastes were then transferred to temporary ponds. In the west pond, the wastes were slurried with soil and transferred to the south pond. The south pond was eventually filled and the wastes were then stacked to a height of 10 feet above grade. This became known as the sludge mound (see Appendix).

During the mid-1970's, drums were no longer emptied into the pits, instead they were piled at the north end of the main pit. This became known as the drum mound (see Appendix). During the late 1970's monitoring wells were constructed in the southwest corner of the site. These wells indicated the presence of contamination.

The wastes received by the facility included: oil recycling wastes, chlorinated solvents, styrene tar, acids, caustics, paint sludges, lead, chromium, cyanide, arsenic, pesticides, inks, polychlorinated biphenyl's (PCB's) and large quantities of waste from injection wells and other nearby facilities including two NPL sites, Brio and Bio Ecology.

Operations ceased in November 1980. Closure activities continued into 1982. There was an effort made during the closure activities to consolidate the wastes into major source areas. These source areas are identified in the Appendix.

The ROD for the first operable unit signed November 1986, selected several remedial actions which included excavation of the primary source material and separation of the wastes for treatment: solids to be disposed of in an on-site landfill which meets RCRA requirements, organic liquids to be incinerated, and inorganic liquids to be treated by other means as necessary. This is presently in the design phase. A second Remedial Investigation (RI) was begun in February 1988 to determine what type of migration control should be implemented at this site.

### B. SITE VISIT

ATSDR has not conducted a site visit at this time.

## ENVIRONMENTAL CONTAMINATION AND PHYSICAL HAZARDS

### A. ON-SITE CONTAMINATION AND OFF-SITE CONTAMINATION

The project site boundary depicted in the Appendix was the basis for defining on-site and off-site in this Health Assessment. The values recorded in the tables below reflect the data presented in the Field Investigation and Data Summary Report, Volume 1. Although there were other data received by ATSDR, sampling points were not adequately identified, and therefore, were not utilized in the tables.

The results for the surface water and sediment sampling recorded in Appendix H of the Field Investigation and Data Summary Report were not provided to ATSDR for review. However, the discussion provided in the text indicated that methylene chloride and bis (2-ethylhexyl) phthalate (DEHP) were detected in the surface water samples and methylene chloride, fluorotrichloromethane, DEHP, and chloroform were detected in the sediment. (These contaminants may be laboratory artifacts and not site-related.)

**Table 1**
ON-SITE CONTAMINATION

| Contaminants | Soil (mg/Kg) | Groundwater (ug/L) |
|---|---|---|
| Chloroform | ND--.0006 | 3--40 |
| 1,2-Dichloroethane | ND--.180 | ND--1,500 |
| 1,1-Dichloroethene | ND--6.2 | 10--5,300 |
| Tetrachloroethene | ND--16,000 | ND--1,800 |
| 1,1,1-TCA | ND--6,000 | 33--32,000 |
| 1,1,2-TCA | ND--1,100 | ND--1,200 |
| Trichloroethene | ND--1,500 | 29--36,000 |
| trans-1,2-DCE | ND--.009 | 10--46,000 |
| 1,2-DCB | ND--150 | ND--4,300 |
| DDT | -- | ND--57 |
| Chromium | ND--937 | ND--28 |
| Lead | ND--5,470 | -- |
| Methylene Chloride | ND--1,300 | 24--49,000 |
| Xylene (total) | ND--1,500 | -- |
| Toxaphene | ND--160 | -- |
| Aroclor 1260 | ND--19 | -- |

**Table 2**
OFF-SITE CONTAMINATION

| Contaminants | Monitoring (ug/L) | Residential (ug/L) |
|---|---|---|
| Chloroform | ND--1,300 | -- |
| 1,2-Dichloroethane | ND--140,000 | -- |
| 1,1-Dichloroethene | ND--4,900 | ND--6.6 |
| Tetrachloroethene | ND--24,000 | ND--9.2 |
| 1,1,1-TCA | ND--31,000 | ND--29 |
| 1,1,2-TCA | ND--50,000 | ND--120 |
| Trichloroethene | ND--8,000 | ND--63 |
| trans-1,2-DCE | ND--3,600 | ND--79 |
| 1,2-DCB | ND--40 | -- |
| Chromium | ND--223 | -- |
| Lead | ND--23 | ND--23 |

Legend

TCA trichloroethane
DCE dichloroethene
DCB dichlorobenzene
DDT dichlorodiphenyltrichloroethane
-- no concentration reported

B. PHYSICAL HAZARDS

There are no reported physical hazards present at this site.

## DEMOGRAPHICS OF POPULATION NEAR SITE

The area surrounding the site is used to graze cattle. A chain-link fence was installed in 1987 which eliminated the past problem with cattle grazing on-site. There are two buildings located on-site. One was the former sludge drying building located northeast of the drum mound. The other was a barn located between the sludge mound and the main pit, which was used as an office. The site is located 15 miles southwest of Norman, Oklahoma, and one-half mile east of the community of Criner. The nearest residence is located along the southwest site boundary.

## EVALUATION

A. SITE CHARACTERIZATION (DATA NEEDS AND EVALUATION)

1. Environmental Media

The soil contamination has been well defined. The groundwater and surface water, and the interactions between them, will need to be more completely characterized in the future to determine public health implications. This further characterization should be addressed in the second operable unit (migration control) RI. A drinking water survey should be conducted and a map developed which indicate the location and population using the groundwater (public and private wells) or the surface water.

2. Land Use and Demographics

The land use and demographic data provided to ATSDR were incomplete. Additional information on the current use of residential wells near the site would be useful to ATSDR. If this information does not already exist it should be gathered during the second RI.

3. Quality Assurance/Quality Control

Conclusions contained in this Health Assessment are based on the information received by ATSDR. The accuracy of these conclusions is determined by the availability and reliability of the data.

B. ENVIRONMENTAL PATHWAYS

The bulk of the contamination present on-site is located in the subsurface soil. This contamination is the primary source of the contamination in the other media. The first operable unit ROD requires the excavation of all principal source areas and the appropriate treatment and disposal of such materials. This action should help to decrease the migration of the contamination from these source areas. Additional soil sampling during the second operable unit RI should identify any additional areas of soil contamination.

The groundwater at the site is located in two geologic formations near the site. One formation which is the primary source of drinking water in the area, is the alluvium of North Criner Creek, which is 40 to 60 feet deep at mid-valley. The other formation is the Hennesey Formation which is composed of fractured shale, mudstone, and sandstone. The water located in the upper sediments is potable, but deeper it becomes salty and brackish.

The flow of the groundwater has not been well defined at this time. It appears to flow to the southwest and the east. Leachate has been detected up to 50 feet below the bedrock as well as 400 to 2,000 feet laterally in the bedrock. This is a result of the strong downward gradient and the fractured Hennesey Formation. Contamination has also been detected in the alluvium of North Criner Creek 2,000 feet southwest of the site. The plume is estimated to be 1,000 feet long. The mechanism of this transport is unknown and will be the subject of further study during the second operable unit RI.

The North Criner Creek flows from the northwest to the southeast and is located south of the site. Its alluvial valley extends almost to the southwest corner of the site. North Criner Creek joins Criner Creek approximately 1 mile south of the site. There is also a creek located about 400 feet east of the waste disposal areas. This stream was impounded to create 3 small lakes which cover approximately 6 acres, total. There is a 2-acre pond located 1,500 feet west of the drum mound. Surface water and sediment samples were taken at various locations at the site. These samples indicated the presence of contamination. The additional sampling planned for the second operable unit RI should include surface water and sediment samples to better characterize those media.

There was no ambient air sampling conducted at this site. Without any data to the contrary, air must be considered a potential medium of concern.

Potential environmental pathways at this site include migration of contamination from the primary source areas and the soil to the groundwater, surface water and sediment, biota, and air. There is also the potential for the contamination to migrate between the various media.

C. HUMAN EXPOSURE PATHWAYS

The potential human exposure pathways for this site are ingestion of contaminated soils, groundwater, and surface water; inhalation of dusts or vapors from the source areas, the contaminated soil, or the contaminated groundwater; and dermal exposure to contaminated soil, groundwater, surface water, or sediment.

Inhalation of dusts and vapors generated on-site from the soils is a potential exposure pathway for remedial workers and trespassers at the site. People may be exposed to contamination while performing tasks that require disruption of the soil, thereby causing a release of contaminated dust and vapors. This potential exposure will decrease once remedial work requiring excavation of the contaminated soil and construction of the on-site landfill is complete. Off-site there is a potential for exposure from fugitive dusts and vapors generated by disrupting the soil at the site, and inhalation of vapors generated while using the contaminated groundwater could occur if water from contaminated wells was used for showering, irrigation, washing cars, etc.

Ingestion of contaminated groundwater is a potential public health concern, off-site. The maximum concentration of trichloroethylene (TCE) (63 ug/L), and trans-1,2-DCE (120 ug/L) reported in Table 2 above, were detected in a residential well that was no longer in use at the time of the sampling. However, the maximum concentration of lead (23 ug/L) reported, was detected in a residential well which was still in use. This concentration of lead is of public health concern. According to the Environmental Protection Agency these homes have been provided alternate water. There is no known use of the groundwater on-site. The concentrations of contaminants detected in the groundwater monitoring wells located on-site are of public health concern and the water should not be used for domestic or agricultural purposes.

Ingestion of soil is a potential human exposure pathway on-site. The problem will center around the workplace (people eating lunch with dirty hands, wiping dirt on their face, etc.). Dermal exposure is a potential human exposure pathway from working with the contaminated soils, especially in the locations of the primary source areas. This potential exposure will decrease once the contaminated soils are contained within the landfill.

There is a possibility of incidental ingestion and dermal exposure to surface water and sediments at the site. The surface water features in the area may be used for recreational activities (e.g., wading, fishing, etc.).

Human exposure pathways that are of public health concern are inhalation of fugitive dusts and vapors generated on-site and vapors generated from use of groundwater off-site; ingestion of contaminated soils, surface water, and groundwater; and dermal absorption of contamination from soil, sediments, surface water, and groundwater.

## PUBLIC HEALTH IMPLICATIONS

Much of the contamination detected in the various media are VOC's. Some of these VOC's may cause depression of the central nervous system at high concentrations. Also, some VOC's cause liver and kidney toxicity as well as damage to the pulmonary and hematopoietic systems. In addition, there is evidence that some VOC's are carcinogenic in laboratory animals.

TCE given orally in doses of 24 or 240 mg/kg/d for a period of 14 days produced effects including increased liver weight, decreased hematocrit, and depressed cell-mediated immune response (Tucker et al., 1982, Sanders et al., 1982). Based on liver tumor production in mice, the Environmental Protection Agency (EPA) has designated TCE as a potential human carcinogen. It is unknown how long residents may have been drinking or using for domestic purposes the highly contaminated water present in the plume. Long-term exposure to TCE at the maximum contamination detected in residential wells could result in a significant, increased risk of cancer and other non-carcinogenic toxic effects such as liver damage and depression of immune function. Therefore the use of this groundwater for drinking, bathing, and other domestic uses is not acceptable.

Lead is known to cause neurological effects in gestating fetuses, neonates, and young children. It can also cause peripheral neuropathy in adults. Other adverse health effects caused by lead include: hypertension, growth retardation, and effects on heme synthesis enzymes and the cell membrane. The maximum concentration of lead detected in the soil at this site was 5,470 mg/Kg and in the residential wells, 23 ug/L. Ingestion of lead at these concentrations is of public health concern.

Acute PCB-related health effects typically occur at higher concentrations than those detected on-site. However, for this site, the primary identified potential health effects, resulting from exposure to PCB's through ingestion, inhalation, and dermal contact, are carcinogenic effects. PCB's, have been designated as Group B2--Probable Human Carcinogens (EPA 1987). This designation is based on experiments which demonstrated the induction of hepatocellular carcinomas in laboratory animals fed high doses of PCB's in their diet (Kimbrough et al., 1975; Norback and Weltman, 1985).

The toxicity of chromium is dependent upon the valence of the cation present (Cr VI or Cr III) and the anion to which it is bound. The valance of the chromium detected at the site was not established; therefore, this assessment is based on the potential toxic effects of Cr VI, which is the more toxic form. The cell membrane is penetrated by Cr VI more easily than Cr III. Once inside the cell, Cr VI is converted to Cr III, which then complexes with deoxyribonucleic acid (DNA) providing an opportunity for cell mutation (EPA 1987). Dermal contact with Cr VI may result in dermatitis or skin ulceration. Chromium can also cause kidney and liver damage. The maximum concentration found in the soil was 937 mg/Kg. Ingestion of chromium at this concentration is of public health concern.

## CONCLUSIONS AND RECOMMENDATIONS

### A. CONCLUSIONS

This site is of potential health concern because of the risk to human health resulting from possible exposure to hazardous substances at concentrations that may result in adverse health effects. As noted in the Environmental Pathways and Human Exposure Pathways Sections, human exposure to contaminated soil, groundwater, surface water, sediment, air, and biota may have occurred in the past or may be occurring now. The actions in the ROD should reduce the potential exposures to the soil and should reduce the potential for the migration of contamination from the source. The second operable unit RI should provide the additional information required to determine what migration controls should be implemented at the site.

B. RECOMMENDATIONS

1. During remediation, measures should be taken to protect people on-site and off-site from exposure to any dusts or vapors that may be released. Workers on-site should be provided adequate protective equipment and training, in accordance with 29 CFR 1910.120, and should follow appropriate National Institute for Occupational Safety and Health and Occupational Safety and Health Administration guidelines, when involved in activities that may result in an exposure. Workers should implement optimal dust control measures. During working hours, appropriate monitoring should be utilized at the worksite periphery to protect nearby workers and residents.

2. The information requested in the Data Needs and Evaluation Section of this Health Assessment should be provided to ATSDR.

3. In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act as amended, Hardage/Criner NPL Site has been evaluated for appropriate follow-up with respect to health effects studies. Although there are indications that human exposure to on-site or off-site contamination may have occurred in the past, this site is not being considered for follow-up health studies at this time because the level and extent of possible human exposure to site chemicals has not been defined and it is unclear that current exposure is occurring. However, if data become available suggesting that human exposure to significant levels of hazardous substances is currently occurring or has occurred in the past, ATSDR will reevaluate this site for any indicated follow-up.

**PREPARERS OF REPORT**

Environmental Reviewer: Susan L. Mueller, Environmental Health Specialist, Health Sciences Branch.

Regional Representative: Carl Hickam, ATSDR Regional Representative, Region VI.

## REFERENCES


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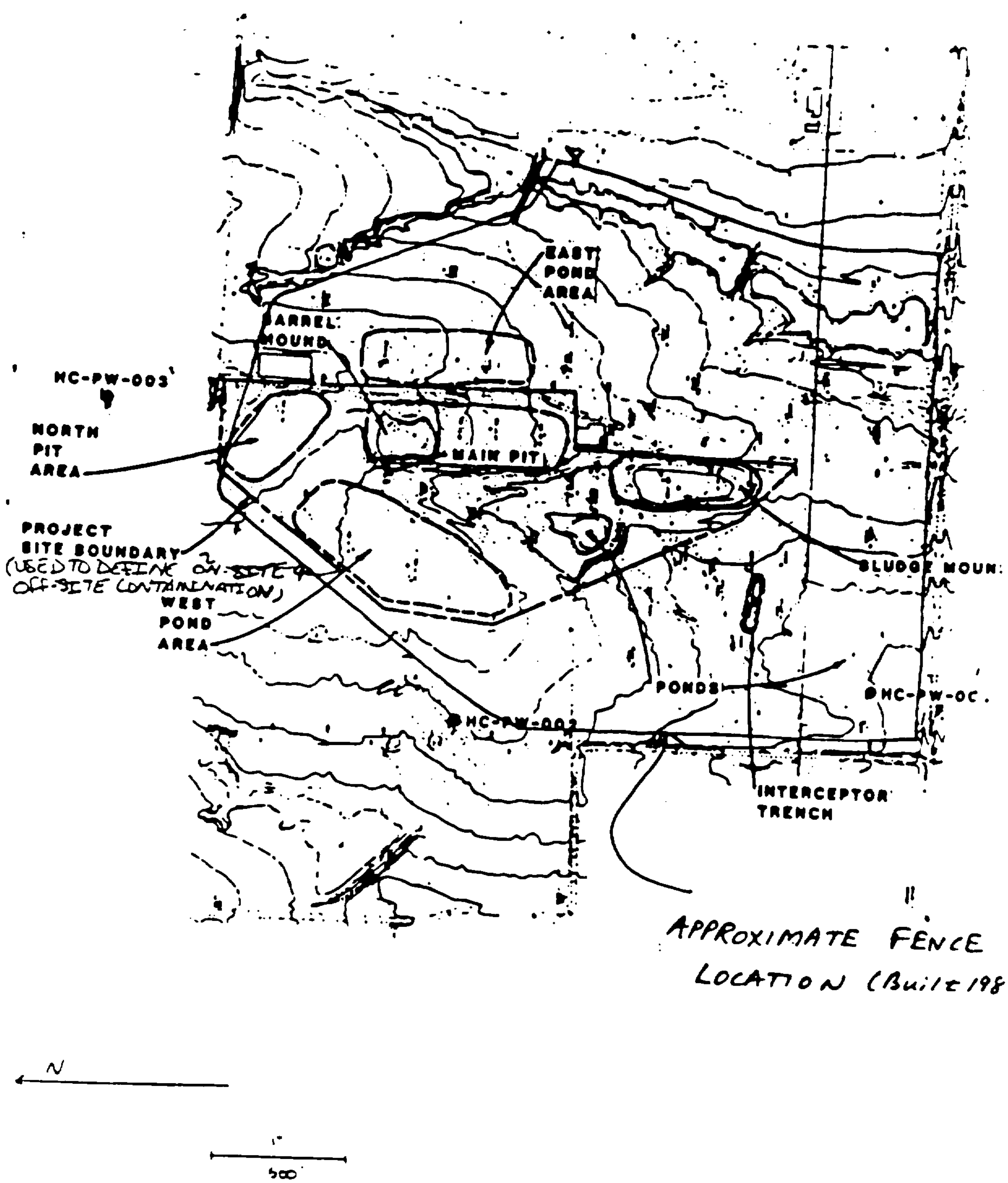
APPENDIX

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PURCELL SERIES WELLS

HARDAGE/CRINER SITE OK-86

APPENDIX C

ADMINISTRATIVE RECORD INDEX
(with Addendum)

Administrative Record Index
not included.

APPENDIX D

STATE OF OKLAHOMA CORRESPONDENCE

Joan K. Leavitt, M.D.
Commissioner

HAZARDOUS WASTE MGMT. DIV

OKLAHOMA STATE
DEPARTMENT OF HEALTH

P.O. BOX 53551
1000 N.E. TENTH
OKLAHOMA CITY, OK 73152

AN EQUAL OPPORTUNITY EMPLOYER



November 13, 1989

Allyn M. Davis, Ph.D (6H)
Director
Hazardous Waste Management Division
EPA Region VI
1445 Ross Ave.
Dallas TX 75202

Dear Dr. Davis:

I was surprised to receive your letter requesting concurrence on the Hardage/ Criner Proposed Remedial Action Plan. We were awaiting additional information and we were given only one working day to formulate a reply.

Please be advised that the discussions we have had with representatives of your agency have not served to eliminate several of our concerns regarding your proposed plan. As you are aware, the Oklahoma State Department of Health (OSDH) received the Remedy Report for the Hardage Industrial Waste Site on October 13, 1989 and subsequently requested briefings in order to gain an appreciation of your proposal. During the briefings your staff was unable to answer any of our questions relative to risk analysis, condition of the barrels and amount of liquids in barrels. Additionally, only some of our concerns relative to control of air emissions and other basic information and assumptions upon which the proposed plan is built were answered.
Your staff promised to forward information relative to some of these issues; however, the information received was either unconvincing or not pertinent to these issues. The important question of relative risk has been left unanswered.

OSDH believes that several of the remedial action technologies proposed for site clean up have merit and in the interest of public health should be instituted as soon as practicable.

elements of merit:

- Southwest trench or wells - Institute immediately
- V-shaped trench - Institute immediately
- Liquid extraction wells
- Vapor extraction wells - If this element is part of a permanent cap with a vapor control component.

OSDH also believes that there are serious problems with several proposed clean up technologies presented in the Remedy Report and that these elements of the plan have potential for increasing health risks to the public.

elements of disagreement:

Drum lancing - not recommended
Excavation of drums - not recommended
U-shaped trench - not recommended
Catalytic thermal treatment - as presented will not meet CAA requirements or BACT.

The Oklahoma State Department of Health does not agree with significant elements of EPA's Remedial Action plan for the Hardage/Criner Superfund site as presented and explained to us, therefor, OSDH cannot concur with the proposed plan based on the information currently available.

If you have any questions regarding this matter please call me at (405) 271-8056.

Very truly yours,

Mark S. Coleman

Mark S. Coleman
Deputy Commissioner
for Environmental Health

# APPENDIX E

## RESPONSIVENESS SUMMARY

Hardage/Criner Site
Community Relations Responsiveness Summary

The Community Relations Responsiveness Summary has been prepared to provide written responses to comments submitted regarding the proposed plan at the Hardage/Criner hazardous waste site. The summary is divided into two sections:

Section I: Background of Community Involvement and Concerns. This section provides a brief history of community interest and concerns raised during the remedial planning activities at the Hardage/Criner site.

Section II: Summary of Major Comments Received. The comments (both oral and written) are summarized and EPA's responses are provided.

## I. Background of Community Involvement and Concerns

Individual interest or attention to the site has been moderate since the signing of the 1986 Record of Decision for source control. Individual residents are concerned about their health, food chain impacts, as well as the economy of the area. Residents at the public meeting in October of 1989 indicated their desire for more frequent updates on activities and plans for the site, and for credibility of the remediation through the removal of wastes from the site.

## II. Summary of Major Comments Received

Public notice announcing the public comment period and opportunity for a public meeting was given on October 1, 1989. The Proposed Plan fact sheet was distributed to the site mailing list on October 12, 1989. Fact sheets were also sent to site repositories on this date, along with documents comprising EPA's Administrative Record for the site. The comment period began on October 13 and ended on November 2, 1989. A public meeting was held on October 26, 1989, at the Grady County Fairgrounds Community Building in Chickasha. The purpose of this meeting was to explain the results of the Remedial Investigation and Feasibility Study for groundwater, and to explain changes in the source control remedy since the 1986 Record of Decision for the site. Approximately 40 people were in attendance, and a number of questions and comments were received. Two letters were received with questions as well.

The comments/ uestions received during the public comment period concerned the following

- o the timi·g and exact location of remedial activities
- o the impa t of contaminated groundwater on the food chain and health
- o safety a·d health concerns during remediation
- o the loca :on and announcement of future public meetings.
- o need for .he excavation of drums

Comments were received from the following citizens: Marvin Lyles, Edwin Kessley, Royce Smith, Eilene Whitehead, Kay Hixon and George (Buddy) McKinnon. Letters were received from George McKinnon and Lisa Ozment with Progressive Environmental Management, Inc. Comments received are summarized below, along with EPA responses.

Question #1. Will there be any problems with the roads due to movement of equipment?

Response: The majority of the activities at the site during remediation will take place within the site boundaries. There will be some movement of equipment onto the site to perform the work. The only regular movement will be the shipment of the liquids removed from the source areas as they are taken offsite to be destroyed. These liquids will be accumulated until a load is ready for shipment.

Question #2. Why weren't the source areas covered during the time of the investigations to prevent the infiltration of rainwater?

Response: Actions were taken to eliminate immediate threats at the site, such as erosion of the Barrel Mound. From the end of 1982 when the Hardage property became a Superfund site it was not anticipated that it would take as long as it has for clean-up to begin. This is particularly true of the delay for litigation which has taken place since 1986.

Question #3. Why are there differences in the locations shown for the southwest trench locations in the fact sheet and the overhead during the presentation?

Response: Trench or interceptor well locations shown on overheads during the presentation were only approximate locations specified for the purpose of evaluating alternatives for groundwater control. The trench or interceptor well locations specified in the fact sheet are also approximate and based on the current spread of groundwater contamination. The exact location of the proposed interceptor system will be determined during final design stages of the project, and will be based on the following considerations:

a) the spread of groundwater contamination immediately upgradient of the alluvium;

b) the hydraulic properties of the bedrock (these dictate the exact design requirements); and

c) the location of residential structures and property.

EPA will make efforts to install the interceptor system so as to minimize disruption to homeowners who may be impacted by construction and operation and maintenance activities.

Question #4. Did all of the EPA's information come from the Hardage Steering Committee's investigation or did EPA do its own studies.

Response: Much of the information about the Hardage site has come from multiple sources. EPA, the Oklahoma State Department of Health (OSDH), and the Hardage Steering Committee (HSC) have all gathered information about the site. The most recent investigation, that of the area groundwater, was conducted by the Hardage Steering Committee under the terms of a formal agreement with EPA. Among the terms of the agreement were provisions for EPA oversight of the work, split sampling by EPA to check the HSC's sample results, and EPA review and comment upon the investigation reports, and final EPA approval. EPA has its own experts and employees to examine the information gathered and is not dependent upon the interpretations put on the raw information by the HSC.

Question #5. How deep is the underground water in the area of Mrs. Smith's property?

Response: Water level measurements in the alluvium in this area indicate that the groundwater table is about 15 feet below the ground surface.

Question #6. Is there any threat from eating from pecan trees that have roots into the contaminated groundwater?

Response: Wells in the vicinity of the homestead in question (MW-12, 13, and 28, for example) exhibit detectable concentrations of contaminants. Contaminants detected in the alluvium include the following compounds at the concentrations indicated:

| Compound | Concentration Range (parts per billion) | Drinking Water Standard (parts per billion) |
|---|---|---|
| Total volatile organics (VOC) | 39 - 560 | not set |
| Arsenic | 1 - 7 | 50 |
| Selenium | 6 - 52 | 10 |

As the table indicates, selenium and VOCs are present at levels which pose a concern for drinking water. Whether these contaminanats are taken-up by pecan tree roots is not known. EPA will search for information on exclusion mechanisms in pecan trees, and further evaluate this question.

Question #7. There were noxious fumes from the site during its operation. What about these fumes?

Response: During the time that the Hardage site was open, much of the waste that was brought to the site was exposed to the air. There were open ponds containing waste and drums and piles of more solid material were also left uncovered. This allowed the fumes to escape from these sources. The potential for escape of fumes is dependent on the surface area of contaminated material which is exposed. During the selected remedy, the major potential for such exposure is during excavation of the drums from the Barrel Mound and the Main Pit. Three direct actions will be taken to control the formation of fumes. First, the excavation will be done on the smallest practical working face. This means that the area disturbed to remove the drums and any one time will be kept at a minimum so that as little contaminated material will be exposed to the air as possible. The second step will be constant monitoring of the air both around the excavations and at the fence line. The third is would be the use of engineering controls to prevent vapor release problems. This would entail the use of foam supressants to stop the escape of the fumes up to stopping operations and recovering the exposed areas if the fumes cannot be controlled.

Question 8. Is EPA aware of a report by Kirk Brown from Texas A & M saying that contamination is worse than EPA says?

Response: One of the government's experts for the purposes of the upcoming trial on the Hardage site is Dr. Kirk Brown. Mr. Brown is therefore representing the government and EPA is in agreement with his opinions, which involve significant measures to directly reduce contamination in the main source areas.

Question #9. When will a final decision be made on what will be done to clean up the site?

Response: The Record of Decision which was issued at the same time as this Responsiveness Summary completes the EPA's administrative process for selecting the clean-up method for the site. There is also a trial on this issue which is scheduled to begin on November 27, 1989 in Federal District Court in Oklahoma City and which should last no more than twenty days. The Judge will then give his decision on remedy.

Question #10. The notice that appeared in the Daily Oklahoman was not sufficient to notify the local residents about the meeting on the site. Notice needs to be provided in papers which the local people use.

Response: The regulations governing the issuing of public notice require that a daily paper be used to give the notice. However, that doesn't prevent the placing of additional notices in other papers. In the future additional papers will be used including the Purcell Register, Chickasha Star, and the Blanchard News.

Question #11. The meeting should have been held in McClain County where the site is and not in Grady County.

Response: Future meetings will be held at a location in Purcell.

Question #12. Will transcripts of the meeting be available to the public?

Response: Yes. A copy of the meeting transcript will be placed in the public repository for the site in the Purcell Public Library, the offices of OSDH in Oklahoma City, and at EPA's offices in Dallas. In addition, copies will be available on request from either Mr. Underwood or Ms. Price at EPA.

Question #13. There are carcinogenic compounds in the water that has been used by the Whiteheads (including children and infants) over the past 14 years. This contamination is moving to Criner Creek, which in turn runs into the Washita. At what rate is it moving?

The Whiteheads were provided alternate water from the McClain County Rural Water District No. 7 in 1987. Prior to this, domestic water supplies came from wells installed in North Criner Creek. Groundwater contamination has migrated to a location in North Criner Creek which is approximately 1600 feet downstream of the North Criner Creek bridge on Old State Highway 122. Groundwater flow rates for the upper alluvium are estimated to be between 80 and 170 feet per year and that for the lower alluvium between 9 and 19 feet per year.

Question #14. How many years until this contamination is contained?

Response: Groundwater contamination will be removed when the groundwater interceptor system and source control components (soil vapor extraction, drum excavation and liquid extraction wells) are installed. Construction is expected to take some five months from start to finish. Construction will begin as soon as the litigation ends and the trench design is approved by EPA.

Question #15. Do we know how much contamination is present in Criner Creek?

Response: We know there are levels of contaminants in the North Criner Creek alluvium (see answer to Question #6). Low levels of contaminants have also been detected in surface water samples of North Criner Creek. Contaminants, however, have not reached Criner Creek.

Question #16. How much time will be needed from the time a decision is made to the start of the clean-up?

Response: Once a decision has been made (see Response to Question #9) it normally takes about nine months for clean-up to begin. Unlike most sites, much of the preliminary design has been completed for trial, and therefore work could begin within several months of a final remedy decision.

Question 17. Should the Whiteheads continue to farm?

Response: Results of the Public Health and Environmental Endangerment Assessment (PHEEA) conducted during the groundwater investigation indicate that it is safe for the Whiteheads to farm. The PHEEA evaluated exposure scenarios which assumed dermal contact with affected water and injestion of affected water, beef and milk for various age groups. The results of risks associated with exposure scenarios are summarized in the Second Operable Unit Feasibility Study, which indicate risks below EPA's common acceptability range for risks associated with Superfund clean-ups (1 in 1,000,000 risk). Probable scenarios of future land use were developed for exposure calculations Probable exposure scenarios for a child or adult were a few orders of magnitude below EPA's acceptability range, however, worst case scenario results showed risks from exposure to be between $10^{-4}$ through $10^{-6}$.

Question #18. Will appeals be made to the court decision?

Response: We do not know. Certainly all sides in the case have the legal right to do so, but whether or not that right will be exercised will have to be seen after a ruling has been made.

Question #19. Some of the residents near the site have been told they will have to move for the clean-up. What if they do not want to?

Response: It is not and has never been the position of EPA that any of the area residents would have to move. Because of the need to locate some of the portions of the groundwater portion of the clean-up off of what was the original Hardage site, access to some area properties may be needed to implement the clean-up. EPA does not feel that it is necessary to move for the purpose of institutional controls, but cannot rule out the possibility of temporary re-location during remedy construction. If no agreement can be reached on allowing access to property for implementation of the clean up the government could as a last resort obtain such access through the use of emminent domain. However, the need to resort to such a method has been rare.

Question #20. Is there water contamination to the north? My grandfather drilled three wells in an area of North Criner Creek north of the area of contamination shown in the fact sheet.

Response: Data collect for and by EPA does not indicate that contamination has migrated to this area. To be on the safe side, however, the Oklahoma State Department of Health (OSDH) has sampled the wells in question. The has indicated that results were sent to residents, which showed no detectable contamination.

Question #21. Has all of the seismigraphic work in the area fractured the bedrock?

Response: Geologic studies at the site have revealed details regarding the stratigraphy and structure of the site area. While fractures were noted in the local bedrock, there is no reason to believe these have been caused by seismic testing in the area.

Question #22. Are there faults in the area?

Response: Studies reported in the literature have provided evidence for deep, complex faulting in the Criner region. Depths of over 5000 feet are suggested for such complex faulting. No evidence has been found in the literature to suggest that these faults extend up into the younger (less than about 1000 feet deep) bedrock in the vicinity of the site.

Question #23. Something needs to be done quickly to remedy the site problems.

Response: EPA agrees with this statement. Fortunately the upcoming trial is set for November 27, 1989.

Question #24. The reputation of the area has been devastated and property values depressed. These things aren't being addressed. The only way to restore confidence is to remove the drums from the site completely and highly publicize the event.

Response: The selected remedy calls for the removal and destruction of contaminants contained in the source areas through liquid extraction, excavation, and soil vapor extraction. The rapid and permanent destruction of contaminants is one of the primary benefits of the selected remedy over other options that have been proposed or considered.

Question #25. Once remediation of the Hardage/Criner Site is complete and for some unforeseen reason the selected means of remediation does not prove to be sufficient, will the PRP's be financially responsible for an extended remediation?

Response: Responsibility remains even after remediation. Should additional activity beyond that selected in this Record of Decision be needed the same parties would still be liable for remediaiton. Such determinations are made on the basis of the 5 year Superfund review process and though re-openers in consent agreements, which provide for continuing liability if additional work becomes necessary.

Question #26. If material from the site is transported offsite to another disposal facility and this facility later becomes a Superfund site will the PRP's be financially responsible for the material transported to the site from Hardage/Criner?

Response: The generators of the material would still be responsible for it. This scenario is not expected to occur as the materials taken offsite should be destroyed in compliance with EPA regulations.

Question #27. Can the land be put back like it was?

Response: No. The best that can be done is to remove and destroy as much of the contamination as is possible and to reduce the threat posed by what contamination remains by limiting its mobility and by careful maintenance and monitoring of the site. Because of the need to maintain a cap on the site, the land will very likely lay fallow.

Question #28. (OSDH) The objective of Superfund is the protection of public health and the environment. Any release of contamination into the water or air resulting from the remedial action at the site is inappropriate and runs counter to this objective.

Response: The objective of Superfund is the protection of human health and the environment. This objective includes protection from both long-term and short-term risks. The short-term risks posed by excavation of the drums from the source areas exist, but can be controlled as described in the Response to Question #7 for releases to air. The excavation of buried drums is an established technique which has been successful at similar hazardous waste sites. Experience at such sites has shown the precautions which need to be taken to minimize any short-term risks to the site workers or to the public.

The long-term risks associated with the Hardage site are a grave concern. Ultimately this concern can only be minimized by the recovery and destruction of the contaminants. No one can predict what will occur over time as the drums buried in the source areas corrode and continue to release their contamination to escape into the environment. As these wastes mix and migrate the risks they pose will continue. These risks include chronic, long-term risks posed by carcinogenic compounds. With no known time limit for the release of the contamination from the source areas a choice is apparent between rapid removal and destruction of contaminants using pre-planned engineering and safety controls successful in other similar excavtions. The alternative is attempts, with many uncertainties, to achieve long-term containment of hazardous and carcinogenic contaminants which are mobile and subject to continued release into the environment under conditions that are neither known or controlled.

Question #29. (OSDH) The data provided does not support the volume or condition of the drummed waste that was used to justify the removal component of the proposed plan.

Response: It is true that assumptions have been made about how many of the buried drums still contain liquid waste. Faced with the choice of hoping that perhaps all or most of the drums are empty or making the more conservative assumption that they are not, EPA assumes that they continue to pose a threat. Given the stakes, the health of local residents and the environment, we would rather take the precaution of making this assumption and then discover that the drums are empty than gamble that they are empty and later be tragically proven wrong.

Question #30. Can we be confident that all areas relating to soil vapor extraction have been addressed? Can we be confident in the catalytic oxidation process and that this in itself would not contaminate the air?

Response: Once EPA selects the final remedy for the site, a detailed remedy design will be prepared and approved. This design will necessarily address all areas of concern during remediation, including refining the areas of contamination, evaluation in detail the performance of soil vapor extraction, and covering details of health and safety during remedial activities. As far a catalytic oxidation is concerned, EPA is required to utilize the Best Available Control Technology (BACT) for the destruction of contaminated vapors resulting from soil vapor extraction. This is a requirement of the Clean

Air Act and State regulations. If catalytic oxidation does not meet BACT, then an alternate thermal destruction technology will be used. Air monitoring onsite and at site boundaries will be instituted to assure air quality remains below action levels desiged to protect human health.

Question #31. The rural water system should be extended to those concerned about possible domestic groundwater contamination.

Response: There are currently no plans to further extend the rural water system through Superfund. Conditions which would warrent such an extension, such as threatened or impacted groundwater in drainages outside North Criner Creek, do not exist. Questions about potential groundwater contamination from the site have been evaluated and indicates that groundwater plumes are migrating primarily into the alluvium of North Criner Creek where alternate water has been supplied. Planned actions in the alluvium would assure that contamination in the alluvium is geographically controlled and concentrations reduced.

Question #32. A park or recreation area should be set up with information about the site.

Response: EPA has established a repository at the Purcell Public Library which contains all such information.

EPA responses to revisions of the Second Operable Unit reports prepared by ERM-Southwest are found on the following three pages. These revisions were submitted to EPA during the public comment period and are treated since EPA approved the Second Operable Unit RI/FS prior to this time.

TECHNICAL REVIEW COMMENTS
AMENDMENT NO. 1

SECOND OPERABLE UNIT
REMEDIAL INVESTIGATION REPORT
REVISION NO. 1 HARDAGE SUPERFUND SITE
CRINER, OKLAHOMA

The United States Environmental Protection Agency (EPA) conducted a technical review of the Revision No. 1, dated October 10, 1989, to the Second Operable Unit (OU) Remedial Investigation Report (RI) prepared by ERM-Southwest, Inc. Users of the RI should be aware that EPA has a number of comments and technical concerns regarding the report and its Revision No. 1.

Previous EPA review comments were organized to align with the Summary and Conclusions Section (Chapter 6) of the RI report. Individual responses were presented for each of 54 conclusions in Chapter 6. These responses addressed the major areas of concern that EPA has with the RI.

This amendment addresses the October 10, 1989 major revisions to the Summary and Conclusions section (Chapter 6) of the RI report. The revised conclusion is noted and the new response is presented beneath it. Comments could be raised for each of the revised technical sections and subsections of the report.

Users of the RI should therefore consider EPA's broad responses and noted data limitations as needed when reviewing the individual technical sections or appendixes contained within the RI.

Revised Conclusion
Chapter 6--Introductory Paragraphs

EPA disagrees that Stratum II is relatively impermeable; while it may be of lower overall permeability than overlying or underlying units, Stratum II contains fractures and sandstone lenses. The source mounds are also not entirely within the bounds of Stratum II. Excavation of the source mounds into Stratum I sandstones is also suspected.

The presence of drummed solids and liquids in other portions of the Main Pit (besides the west side) is also expected.

Data developed by the HSC expert panel investigation was sponsored by the HSC for their ongoing litigation purposes. This study, as part of litigation, has not been endorsed by EPA.

Revised Conclusion No. 11

EPA does not agree with the characterization of Stratum II as a low permeability unit.

The hydraulic head measurements alone do not yield information on the vertical rate of groundwater movement through Stratum II. Hydraulic conductivity and porosity values are also necessary.

EPA does not agree with ERM's revised groundwater velocities for Stratum I and Stratum III. ERM's values were calculated using median hydraulic conductivity values and the lowest hydraulic gradient observed during the study. Recalculating the velocities using the range of measured hydraulic conductivities and hydraulic gradients reveals that Stratum I velocities could range from 1/2 to 1,000 feet per year and Stratum III velocities could range from 0.003 to 250 feet per year.

Revised Conclusion No. 15

No comment.

Revised Conclusion No. 21

EPA desires to state that the period of record, while revised to include a longer period, is still relatively short and may therefore not be fully representative of the range of flows that may be encountered in the creek.

Revised Conclusion No. 26

The peak flow measured for the south pond may not be relevant since it is controlled by discharge through a pipe rather than site hydrology.

It should be noted that the period of record, while revised to include a longer period, is still relatively short and may therefore not be fully representative of the range of flow from the south pond or the alluvium.

**Revised Conclusion No. 43**

The modeling performed by SSPA was not conducted as an approved task under the second OU work plan. This modeling is being performed as a result of the HSC litigation effort and will be evaluated separately.

As stated in previous responses, EPA does not agree that the contamination found in the alluvial system is predominantly the result of surfical transport.

**Revised Conclusion No. 45**

See Revised Conclusion No. 43 response.

**Revised Conclusion Nos. 54 and 55**

The PHEEA does not address the exposure pathway that led to the provision of an alternative drinking water supply to the residents previously dependent on well water from the North Criner Creek alluvium. The PHEEA also ignores the potential exposure of humans via the ingestion of aquatic organisms, at an annual consumption of about 5 pounds per year, which is possible under a recreational scenario for North Criner Creek. This is very important since the $10^{-6}$ carcinogencic risk criteria for some volatile organic compounds, (such as 1,1-Dichloroethene at 1.85 ug/l) relative to the consumption of aquatic life, is less than CLP contract detection limits.

The PHEEA also does not address a "no action" alternative that action alternative risk reductions can be compared to.

The range of risks developed in the PHEEA are applicable only to the exposure scenarios evaluated and are lacking in that the ingestion of ground water and/or aquatic life potential exposure scenarios are conspicuously absent.

The PHEEA also does not use reference doses, Rfds, nor does it follow the more recent EPA guidance for the preparation of Human Health Evaluations 9285.701A dated July 1989.

APPENDIX F

1986 RECORD OF DECISION
FOR SOURCE CONTROL

RECORD OF DECISION

(ENFORCEMENT DECISION DOCUMENT)

Site

Hardage/Criner located in McClain County, Oklahoma

Documents Reviewed

I am basing my decision on the following documents which describe the cost-effectiveness of source control remedial alternatives for the Hardage/Criner Site:

- Field Investigation and Data Summary Report, Royal Hardage Industrial-Hazardous Waste Site near Criner, Oklahoma, by $CH_2M$ Hill, dated May 1984.
- Source Control Feasibility Study, Royal Hardage Industrial Hazardous Waste Site near Criner, Oklahoma, by $CH_2M$ Hill, dated February 1985.
- Preliminary Public Health Assessment for Groundwater Ingestion for the Hardage/Criner site by $CH_2M$ Hill, dated August 1985.
- Summary of Remedial Alternative Selection, November 1986.
- Data gathered prior to and during enforcement actions in 1982 as described in Appendix A to the Summary of Remedial Alternatives.
- August 1986 memo, Bill Langley to Bob Davis describing review and confirmation of 1984 data from sludge mound sampling.
- Public comments received March 10 - April 15, 1986 on the Source Control Feasibility Study.
- Community Relations Responsiveness Summary, November 1986.
- Staff summaries and recommendations.
- Reference materials for the documents listed above.

Description Of Recommended Final Source Control Remedy

Excavate the principal source areas (drum mound, main pit, and sludge mound) to bedrock and separate wastes for treatment as follows:

- Solids - treatment and disposal in an on-site landfill cell constructed and operated in compliance with the Resource Conservation and Recovery Act of 1976, as amended (RCRA).

- Organic liquids will be incinerated.

- Inorganic liquids will be treated and disposed by other means, as appropriate.

Temporarily close areas of residual contamination at the former source areas until remedial action is selected under the second operable unit.

Decision

Consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Oil and Hazardous Substances Contingency Plan (40 CFR Part 300), I select the remedy described above (alternative number seven from the Source Control Feasibility Study) for the Hardage/Criner site. I have determined that this remedy is cost-effective and is protective of public health and welfare and the environment. The action will require operation and maintenance to maintain the effectiveness of the remedy. Since wastes will be left on-site, the remedial action will be reviewed every five years to assure that the remedy is still protecting public health and the environment. The State of Oklahoma has been consulted on the remedy. I have considered Section 121 of the Superfund Amendments and Reauthorization Act of 1986 (SARA), including the cleanup standards thereof, and certify that the portion of the remedial action covered by this Record of Decision (ROD) complies to the maximum extent practicable with Section 121 of CERCLA (as amended by Section 121 of SARA).

If negotiations are successful, potentially responsible parties (PRPs) will enter into a Consent Decree with EPA authorizing the PRPs to implement the remedial action. In the event that negotiations are unsuccessful, on-going litigation will be pursued by EPA and the Department of Justice in an effort to secure performance of the remedial actions.

11/14/86
Date

Frances E. Phillips
Frances E. Phillips
Acting Regional Administrator

HARDAGE/CRINER
RECORD OF DECISION CONCURRENCE

Allyn M. Davis

Allyn M. Davis, Director
Hazardous Waste Management Division

James O. Neel, Jr. for

Paul Seals
Regional Counsel

J. Walter Frey

for Robert E. Hannesschlager, Chief
Superfund Enforcement Branch

Bennett Stokes

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Solid Waste and Emergency
Response Branch,
Office of Regional Counsel

Larry Wright

Larry D. Wright, Chief
Superfund Enforcement Section

<u>SUMMARY OF REMEDIAL ALTERNATIVES SELECTION</u>

<u>FOR SOURCE CONTROL</u>

HARDAGE/CRINER SUPERFUND SITE

MCCLAIN COUNTY, OKLAHOMA

NOVEMBER 14, 1986

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION
HARDAGE/CRINER
MCCLAIN COUNTY, OKLAHOMA

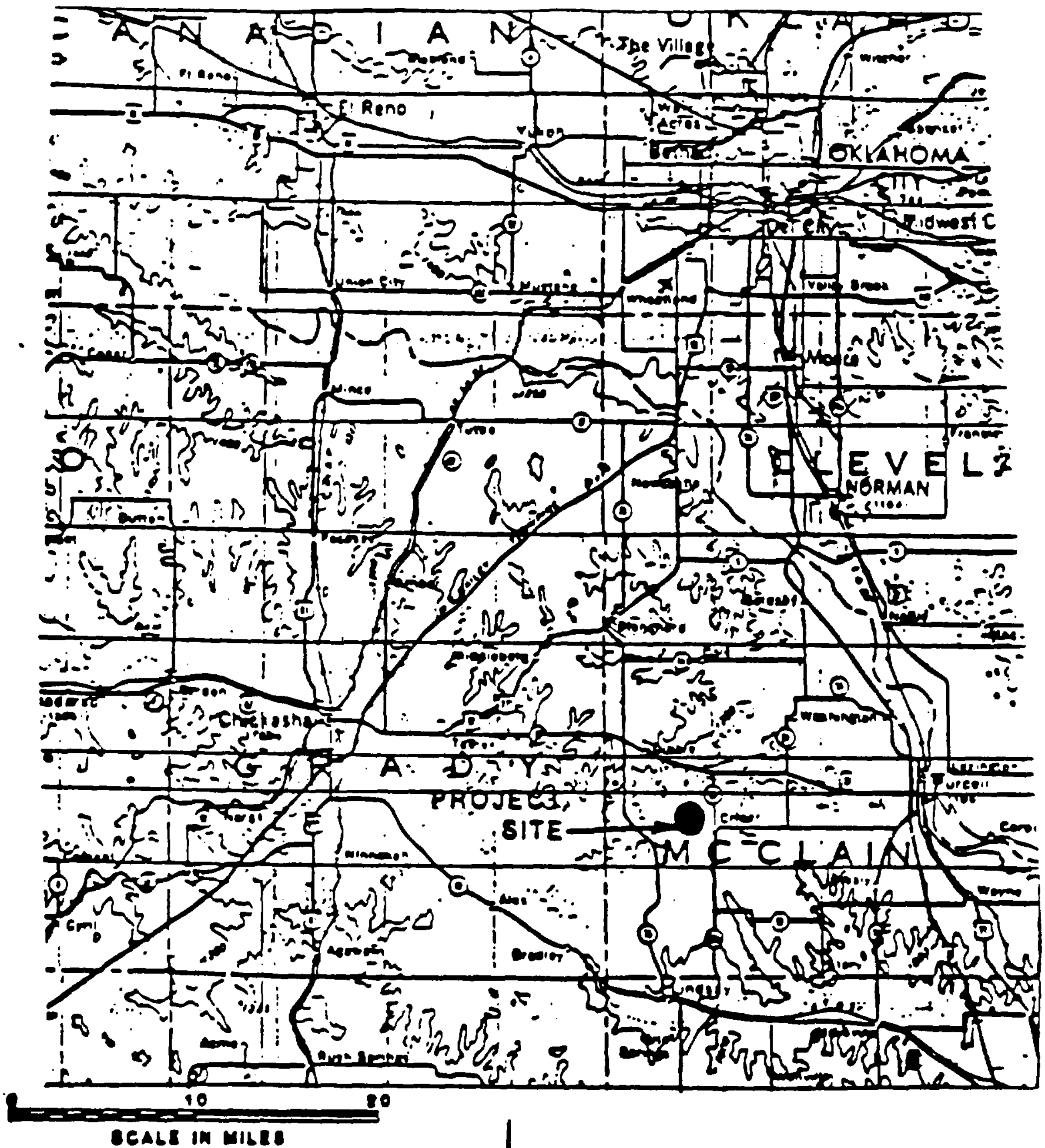
SUMMARY OF REMEDIAL ALTERNATIVE SELECTION
HARDAGE/CRINER
MCCLAIN COUNTY, OKLAHOMA
NOVEMBER - 1986

## 1.0) SITE LOCATION AND DESCRIPTION

The Hardage/Criner site is located in McClain County, Oklahoma, roughly 15 miles southwest of Norman, Oklahoma and 1/2 mile east of the community of Criner (Fig. 1). The area is agricultural with land on all sides of the site used for grazing cattle. Oklahoma Highway 24 forms the southern boundary of the site and a gravel road runs along the east side of the site (Fig. 2).

## 2.0) OPERATING HISTORY

The Royal Hardage Industrial - Hazardous Waste Land Disposal Facility was issued an operating permit by the Oklahoma State Department of Health (OSDH) in September 1972 and commenced construction immediately. Two pits were excavated, the main pit and the south pit. Originally, liquids and sludges from drums and tank trucks were discharged directly to these unlined pits. The methods of liquid disposal were evaporation and infiltration; however, the main pit filled to capacity rapidly. Waste from the pit was transferred to temporary ponds, the "west pond" area, where liquids were slurried with soil, transfered on to the south pit and disposed concurrently with styrene tar and oil recycling residues. The south pit was eventually filled in and waste piled to a height of about 10 feet above grade, forming the "sludge mound". After the first years operation, drums were no longer emptied, but rather piled at the north end of the main pit beginning the "drum mound". The mound was extended southward and built to a height of about thirty feet. In all, roughly 18 to 20 million gallons of waste were disposed at the site during its operation. The sequence of operations has been compiled from OSDH inspection reports and a deposition and hearing testimony of the facility owner/operator. In 1978, the State of Oklahoma filed complaints against the facility for suspected lead poisoning of air around the site. In September 1979, OSDH began proceedings to revoke the facility permit for operating unpermitted pits, failure to seal permeable lenses in the pits, improper closure of pits, failure to retain runoff, and improper storage of wastes. In September 1980, the U.S. Department of Justice (DOJ) filed suit on behalf of the Environmental Protection Agency (EPA) against the facility under Section 7003 of the Resource Conservation and Recovery Act (RCRA). Operations ceased in November 1980 prior to the effective date of RCRA interim status requirements. Royal Hardage then undertook site decontamination and closure efforts which extended into 1982. These efforts consisted of mixing fluids in the pits with soil, excavating visibly contaminated soils from mixing areas and temporary ponds and capping the source areas with a layer of soil. During closure, an effort was made to consolidate wastes in the source areas (sludge mound, main pit, and drum mound).



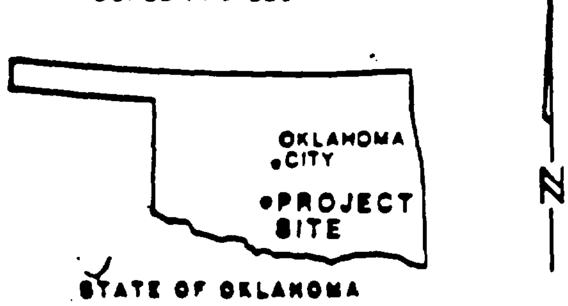




FIGURE 1:

Site location map

(Hardage/Criner ROD 11/86)

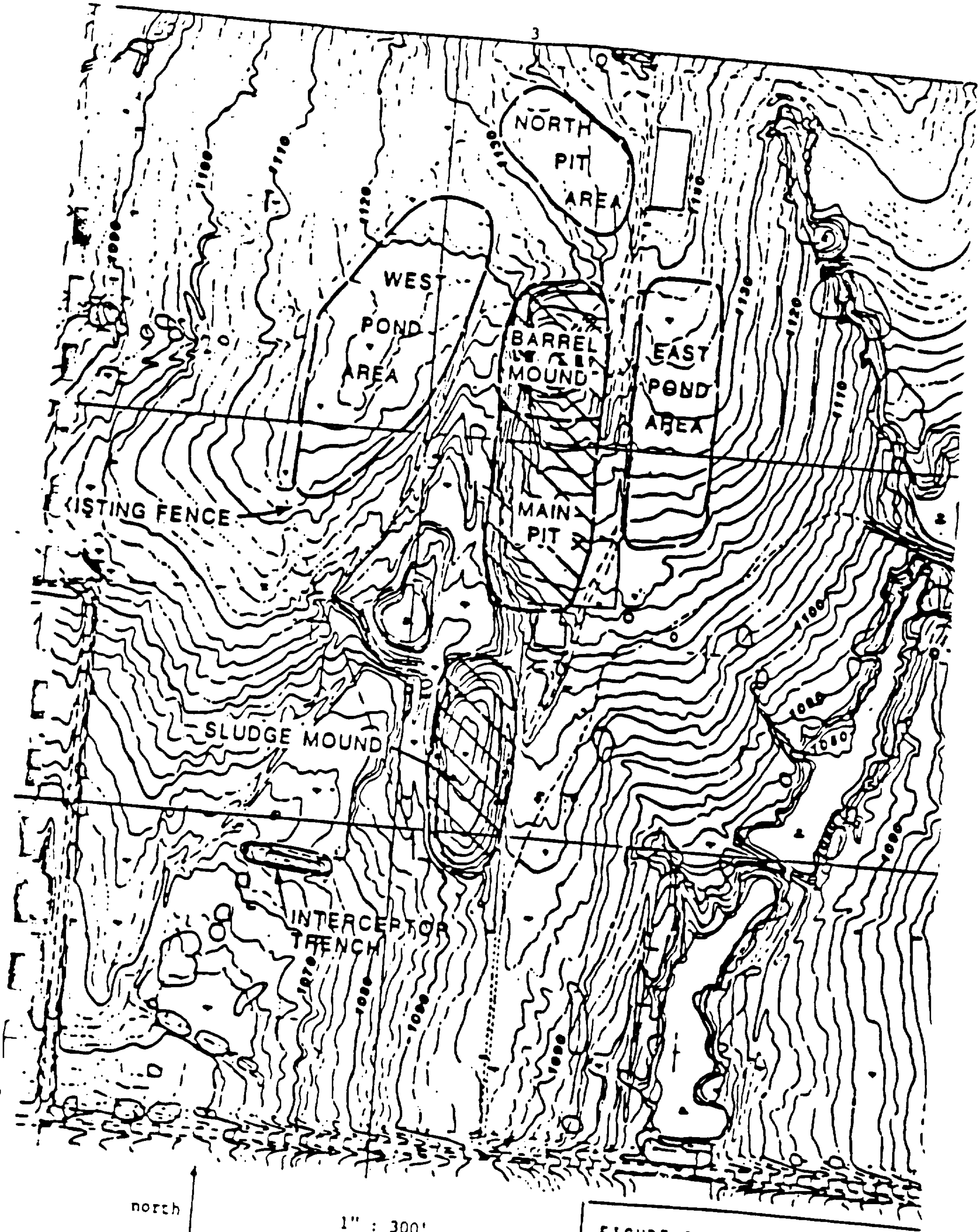



FIGURE 2: Site topographic map

## 3.0) CURRENT SITE STATUS:

### 3.1) Site Investigations:

The site was inspected frequently by OSDH during its operation. Inspectors reported widely varying conditions, with problems initially centered around pits filled to capacity and the potential for overflow. In 1976 OSDH requested that Hardage installed groundwater monitoring wells in the southwest drainage. Eventually, thirteen monitoring wells were installed by the operator. These have been periodically sampled ever since, showing uniformly high levels of contamination. Some Hardage wells may have become contaminated by surface runoff entering the well bore during and immediately after construction. However, repeated purging of these wells has not lowered the levels of contaminants.

EPA first inspected the site in July 1979 due to asbestos disposal. EPA contractor Ecology & Environment (FIT) collected samples at the site in August 1979, August and October 1980, and in March and August 1982. In 1984, work was begun by EPA contractor $CH_2M$ Hill to gather supplemental data to allow preparation of a Feasibility Study (FS) for permanent remedial actions on the site. This supplemental data was compiled and field work was documented in a Data Summary Report (DSR) completed in May 1985. A chronology of EPA sampling efforts prior to 1984 is given Appenoix in A.

### 3.2) Contaminants:

The site was permitted to accept all types of industrial and hazardous wastes except radioactive materials (OSDH-1972). A total 18 to 20 million gallons of waste was logged into the site. The resulting mixture contains virtually every type of waste produced by industries operating in the States of Oklahoma and Texas from 1972 through 1980. The general types of waste accepted at the site included: oil recycling wastes, chlorinated solvents, styrene tars, acids, caustics, paint sludges, lead, chromium, cyanide, arsenic, pesticides, inks, PCBs, and large quantities of waste of unknown content from injection wells and other facilities including what became the Brio and Bio Ecology Superfund sites (Hardage 1972-1980, Eltex 1985). Under each of these broad waste types are numerous specific wastes streams produced from perhaps hundreds of different industrial processes, each waste having it's own unique characteristics, impurities, and inherent hazardous and toxic properties.

Some of the contaminants which pose an immediate threat through groundwater are chlorinated solvents, including: 1,2-dichloroethane, 1,1,2-trichloroethane, 1,1-dichloroethene, tetrachloroethene, and trichloroethene ($CH_2M$ Hill 1986a). Other compounds such as lead, chromium, PCB, and toxaphene are present on the site and will pose long term or permanent hazards due to their persistence in the environment. This is by no means an exhaustive list of either the wastes sent to the site or the contaminants of concern; further information is contained in the source control FS.

3.3) Remaining Features:

Source areas include the main pit, drum mound, and sludge mound (Figure 2). The slude mound covers 1.5 acres to a thickness of from 15 to 20 feet above and within the former south pit.

The main pit covers about two acres with a 15 to 20 foot thickness of waste having been slurried with soil and backfilled into the pit, bringing it to the grade of surrounding land on the east and forming a steep berm 10 to 20 feet high on the west. A high concentration of drums is located along the west side of the pit and in the barrel mound which covers about 0.8 acres to a thickness of 30 to 40 feet. Estimates of the number of unemptied drums remaining in the source areas ranges from 10,000 to over 20,000, with knowledge of site operations and history favoring the latter (Hardage 1972-80).

Other areas of the site were used as temporary holding and mixing ponds or may have been incidentally contaminated during site operations. These areas are the west ponds, east ponds, north pit, and the southwest drzinage (Figure 2).

Two buildings are still on-site. A former sludge drying building used during the last year of operations is located northeast of the drum mound. A barn, used as the office, is between the sludge mound and main pit.

3.4) Hydrology:

North Criner Creek runs in a northwest to southeast direction south of the site with the alluvial valley extending nearly to the southwest corner of the site. This stream is perennial and joins Criner Creek roughly one mile south of the site. Criner Creek empties into the Washita River thirteen miles south of the site.

A stream runs along the east side of the site, about 400 feet east of the waste areas. This stream has been impounded to form a chain of three small lakes totalling about 6 acres. Another two acre pond lies about 1500 feet west of the drum mound.

3.5) Geology:

The site lies in what are commonly referred to as "redbed" sediments. This is a thick sequence of shales, mudstone, and sandstones which gr·:e back and forth over the space of tens to hundreds of feet. The geology was originally described as consisting of the Bison sha'e overlying the Purcell sandstone. Site investigations indicated th e units are not differentiated at the site; so shallow bedrock is ·eferred to collectively as the Hennesey formation ($CH_2M$ Hill 1985).

Beds generally dip to the south and southwest at less than 5°. No major faults are believed to underlie the site. However, a well defined regional joint system is present with joint sets observed at N 20° W, N 20° E, and N 50° W (Kent 1982).

The alluvium of North Criner Creek is 40 to 60 feet deep at mid valley and made up of decomposed bedrock from adjacent uplands.

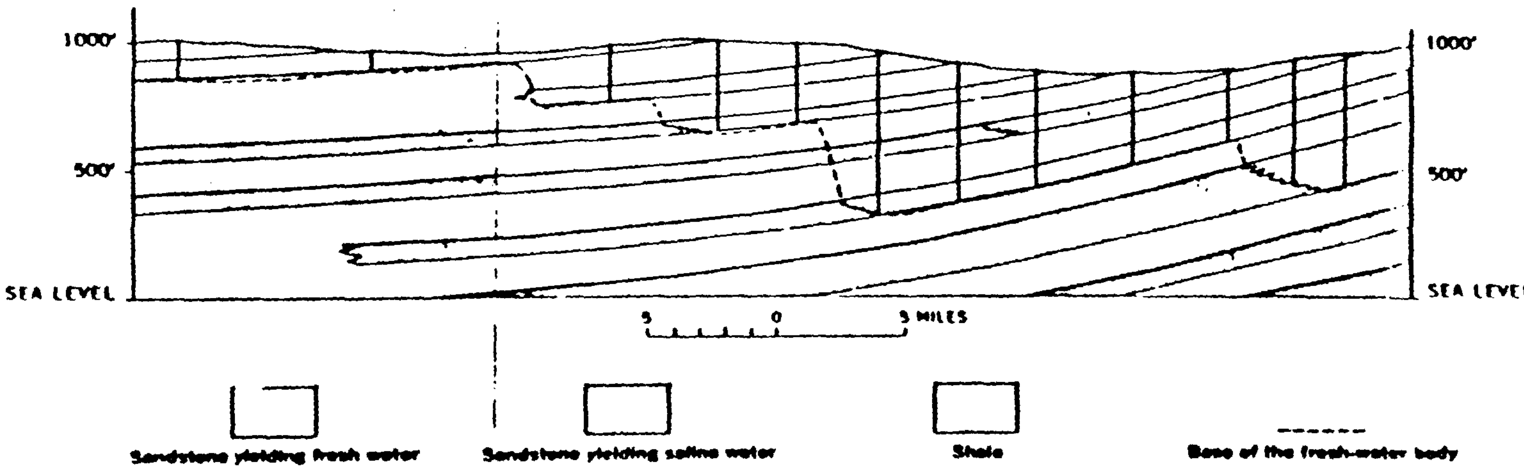
3.6) Geohydrology:

The groundwater table beneath the site generally follows topography and flows are to the southwest and east. Adjacent monitoring wells completed at different depths strongly indicate a vertical (downward) flow component exists. Shales and mudstones underlying the site are fractured and provide a secondary permeability which, coupled with horizontal sandstone beds, has allowed migration of leachate from 400 to as much 2000 feet laterally through the bedrock and over 50 feet beneath the bedrock surface. Questions exist on the method of transport to the southwest, where waste has migrated over 2000 feet by unconfirmed pathways to enter the alluvium of North Criner Creek and apparently form a plume over 1000 feet long in the alluvial aquifer. Further evidence of the bedrock's inadequacy as a barrier to migration is provided by consideration of contamination in two of the $CH_2M$ Hill - 1984 wells (BW-4, GTW-3) and in a series of four FIT - 1982 wells (EW-3,EW-5,EW-6, and EW-7) located to the east and southeast of the sludge mound. These wells are in areas where no site operations occurred and where runoff would not be channeled by topography. The observed 400 feet of migration into these wells over the twelve years between 1984 and 1972 indicates a rate of transport greater than 33 feet per year.

3.7) Areal Groundwater Supplies:

Where possible, residents of the area have drilled water supply wells into the shallow alluvium of streams such as North Criner Creek. However, farms not located in alluvial valleys and without access to these supplies can and have drilled producing wells into the Hennesey formation within one mile of the site. Although not formally classified, both the Criner and North Criner Creek alluvial aquifers and the Hennesey formation would generally be categorized as Class IIb under the EPA Groundwater Protection Strategy.

Fresh water in this area is generally contained in the upper sediments, with water becoming progressively more salty or brackish with depth as indicated in Figure 3 (USGS -1966).




DIAGRAMMATIC SECTION SHOWING BASE OF THE FRESH-WATER BODY IN GENTLY DIPPING SANDSTONE BEDS

**FIGURE 3:**

Regional hydrogeology

3.8) Extent of Contamination:

Groundwater has been contaminated beneath and adjacent to the source areas, in the southwestern drainage, and to the east and southeast of the source areas to depths greater than 50 feet. The alluvium of North Criner Creek has been contaminated, as evidenced by the presence of from 100 to 300 ppb of volatile organic chemicals in three separate wells, which indicates a plume over 1000 feet long (Figure 4). The relative contribution of surface and subsurface pathways to alluvial contamination is unknown. However, transport rates observed on other parts of the site indicate the source areas will, over time, continue or begin to introduce contaminants to the alluvial aquifer through surface and subsurface migration routes.

Soils may be contaminated over several tens of acres as a result of indiscriminant operations and closure. Evidence of this is provided by both visible surface contamination and stressed vegatation. Determination of the extent of surface contamination will require a significant sampling effort during the second unit RI to adequately define the areas requiring remedial measures.

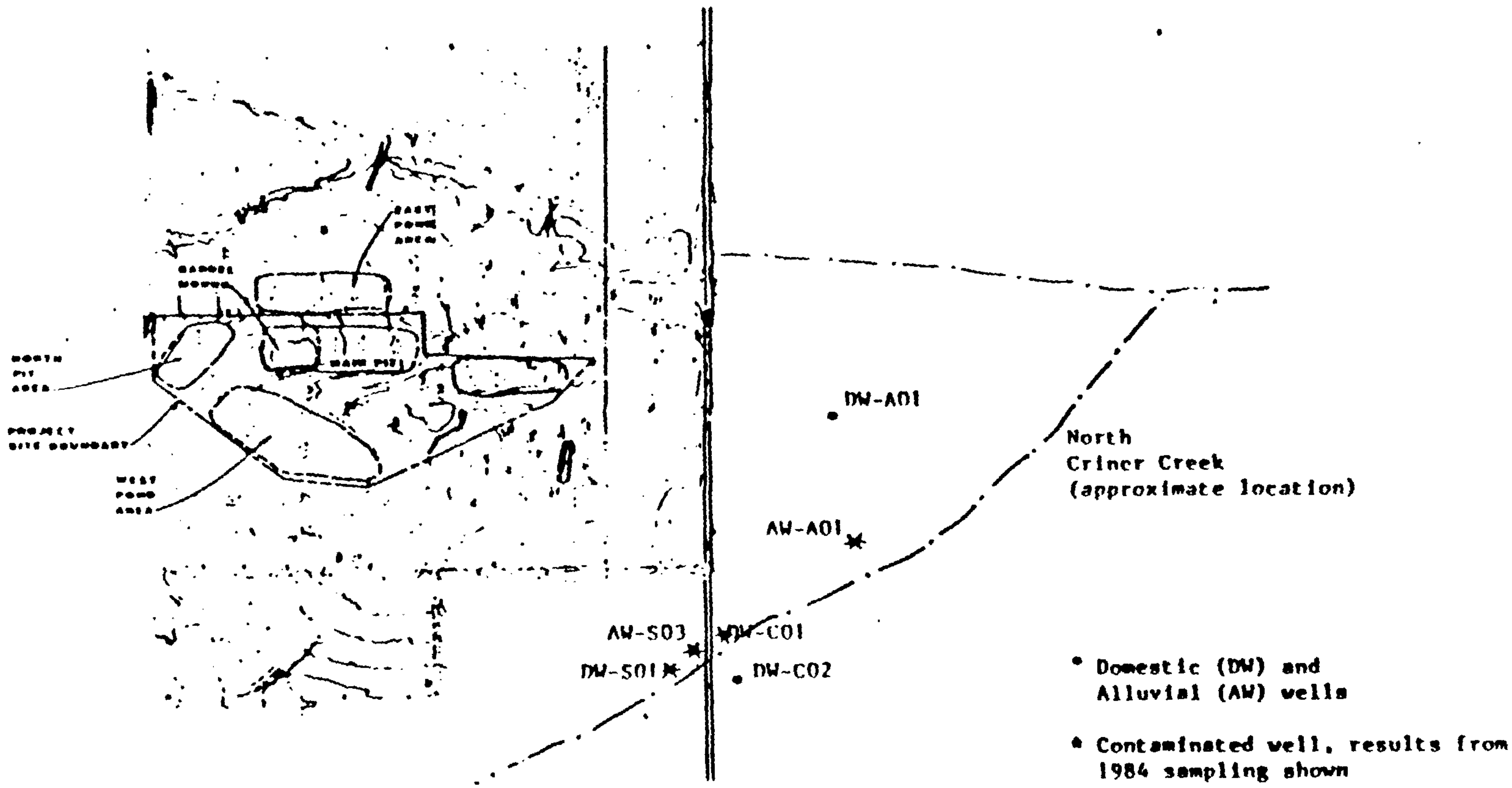
4.0) RISK TO PUBLIC HEALTH AND WELFARE AND THE ENVIRONMENT

Many of the compounds present at the Hardage site are either known or suspected carcinogens. Other compounds either are or are believed to be acutely toxic or capable of causing damage to specific organs. Some of these compounds also bio-accumulate in plant, animal, and human tissues.

The principal routes of exposure for humans are: Groundwater ingestion, direct contact, ingestion resulting from contamination of the food chain and possibly exposure to airborne contaminants.

The alluvial aquifer of North Criner Creek represents the most readily available source of drinking water in the vicinity of the site. This aquifer is contaminated with varying amounts of several chlorinated solvents, as evidenced by sampling of water from the abandoned Corley well and three alluvial monitoring wells. Since several of the compounds detected in these samples are either known or suspected of inducing cancer and/or damage to specific organs of the body, chronic consumption of this groundwater would pose unacceptable health risks.

The Smith and Atkinson/Bearden wells are located 200 and 700 feet respectively from contaminated monitoring wells. Domestic use of water from the abandoned Corley well or the EPA monitoring well AW-S03 would pose lifetime cancer risks in excess of $10^{-4}$. Use of groundwater from on-site would pose an excess lifetime cancer risk averaging 2% and up to 60% ($CH_2M$ Hill, 1986a).




| VOLATILE ORGANICS (ppb) | C01 | A01 | S03 | S01 |
|---|---|---|---|---|
| 1,1-dichloroethane | 29 | 14 | 20 | ND |
| 1,1- dichloroethene | 120 | 82 | 60 | 14 |
| tetrachloroethene | 6.6 | 5.5 | <4 | ND |
| 1,2-trans-dichloroethene | 79 | < | 41 | ND |
| trichloroethene | 9.2 | ND | <3 | ND |
| 1,1,1-trichloroethane | 63 | 6.1 | 30 | < |
| 1,1,2-trichloroethane | 11 | < | 5 | ND |

< less than detection limit
ND not detected

0' 500' 1000'

1 inch: 800 feet

**FIGURE 4:**

Contamination observed in off-site alluvial aquifer of North Criner Creek

(Hardage/Criner ROD 11/86)

Direct contact with wastes on the surface of the site also poses hazards; however, the health risk has not been quantified. Determination of acceptable levels of surface contamination will be a primary concern in the second unit FS. Current human traffic on the site is minimal; but cattle do occasionally graze on the site. Contamination of the food-chain by lead, chromium, pesticides, and PCBs, on the surface of the site poses long-term hazards. This concern has prompted construction of a fence to keep cattle off of the source areas; however, there is evidence of continued intrusion by cattle, giving rise to concerns of food chain contamination. Certain compounds such as pesticides and PCBs have the ability to bioconcentrate through successively higher levels of the food chain (EPA 1985a).

Inhalation of volatiles and contaminated airborne particulates on and possibly adjacent to the site may also pose long term hazards; however, this has not been confirmed.

## 5.0) ALTERNATIVE DEVELOPMENT AND SCREENING

In accordance with Section 300.68(f) of the NCP and EPA guidance documents (EPA 1985b), several alternatives were developed for source control remedial actions at the Hardage/Criner site. Scoping of general alternatives and objectives for remedial action was first discussed in a 1983 meeting between EPA, OSDH, and EPA contractors. After reconsidering these objectives and alternatives in light of the decision to proceed with a source control operable unit, eleven alternatives were developed (Table 1), as documented in the FS. Of these alternatives, four were retained after screening and developed in further detail (see Section 5.2-5.5 below). Estimated cost ranges for the four alternatives retained are shown in Figure 5.

### 5.1) Alternatives eliminated in screening:

The most notable result of alternative screening was the elimination of those plans for containing the wastes in place. Several methods of isolating the wastes and reducing or eliminating their release were considered. After screening of technologies, several in-situ containment plans were developed. Of these, capping in conjunction with vertical trenches to intercept shallow groundwater (Alternative #5) would be expected to be the most effective. While this plan may be the most effective in-situ containment plan, it can by no means be considered as an adequate remedy on that basis alone. Consideration of this alternative did, however, serve as a test of whether or not any form of capping-in-place remedy would sufficiently contain the source areas. Technologies such as slurry walls and groundwater injection/withdrawl were eliminated due to the presence of fractured bedrock, observed vertical migration of contaminants, and the absence of any continuous horizontal bedrock layer at

TABLE 1 - Source Control Remedial Alternatives

> Alternative No. 1 - No Action: no site remedial action taken.

> Alternative No. 2 - Limited Action: remedial action consists of grading, revegetation, fencing and institutional restrictions for the site.

> Alternative No. 3 - Capping: both source areas would be left in place and covered with a multi-layered cap.

> Alternative No. 4 - Upgradient Drains: the source areas would be left in place, covered with a multi-layer cap and upgradient groundwater drains constructed.

> Alternative No. 5 - Perimeter Drains: source areas would be left in place, covered with a multi-layer cap and upgradient and downgradient groundwater drains constructed.

> Alternative No. 6 - Partial Removal: a cap and perimeter drains would be constructed around the sludge mound, the main pit and barrel mound would be excavated, the wastes treated, as needed, and disposed of in an on-site compliant RCRA landfill.

> Alternative No. 7 - On-site Disposal: both source areas would be excavated, the wastes treated, as needed, and disposed of in an on-site RCRA compliant landfill.

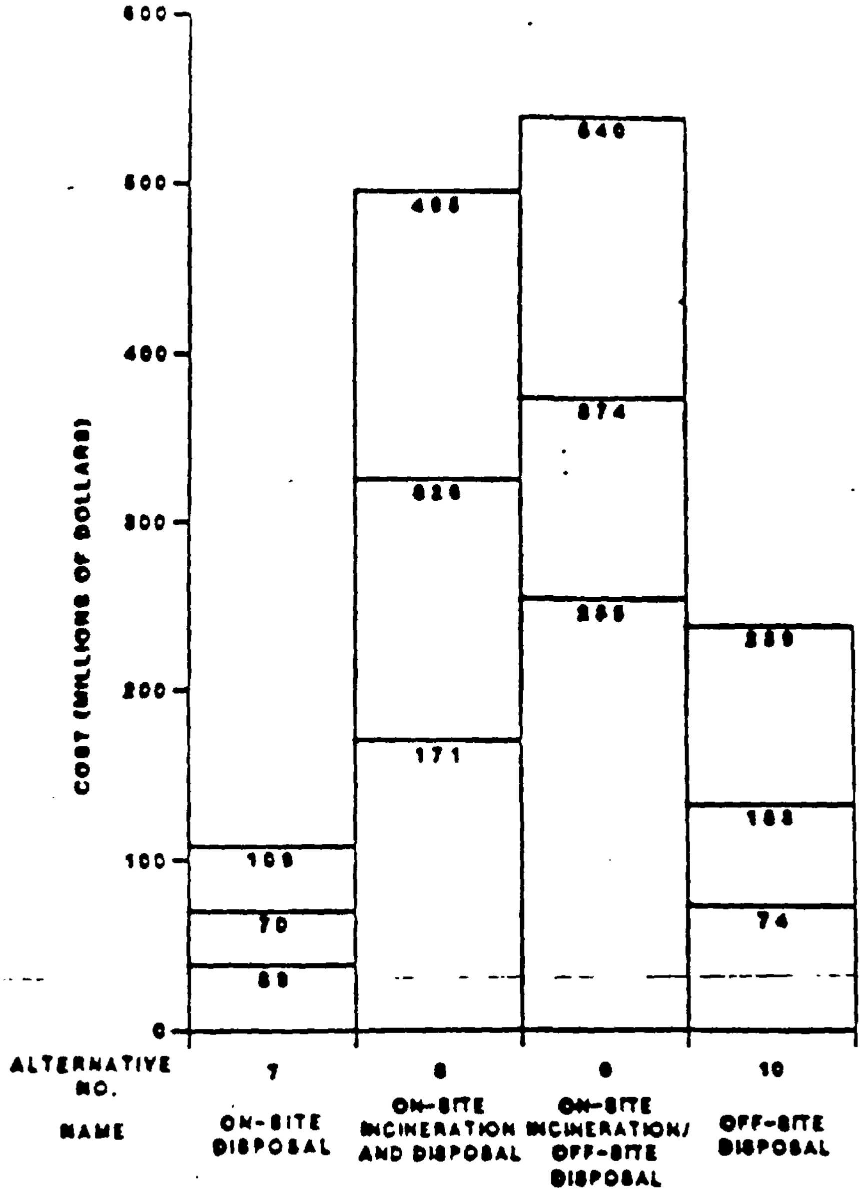
> Alternative No. 8 - On-site Incineration and Disposal: both source areas would be excavated, the wastes incinerated on-site and disposed of in an on-site RCRA compliant landfill.

> Alternative No. 9 - On-site Incineration/Off-site Disposal: source areas would be excavated, the wastes incinerated on site and disposed of in an off-site RCRA compliant landfill.

> Alternative No. 10 - Off-site Disposal: both source areas would be excavated, the wastes treated on-site to meet landfill criteria and transported to an off-site RCRA compliant landfill.

> Alternative No. 11 - Off-site Incineration: both source areas would be excavated and the majority of the wastes transported to an off-site incinerator for incineration and disposal.

* Off-site incineration was assumed in some cases for cost-estimating purposes. This does not reflect a final decision to use off-site disposal facilities for any waste from the Hardage site.




UPPER NUMBER REPRESENTS UPPER-BOUND CONDITION,
MIDDLE NUMBER REPRESENTS BASE CONDITION,
LOWER NUMBER REPRESENTS LOWER-BOUND CONDITION.

FIGURE 5: AR0001865

Costs and sensitivity ranges for source control remedial alternatives

(Hardage/Criner ...

reasonable depth with sufficient integrity to provide a natural base to any engineered containment system. Further discussion of these capping-in-place or in-situ containment technologies and the rationale for their rejection is presented in both the Source Control FS and the Responsiveness Summary (Appendix C).

Consideration of the cap and drain alternative revealed the presence of the same flaws as existed in other plans for containing wastes. The drains were first considered to a depth of five feet below the present groundwater surface. However, migration has been observed to over thirty feet below the water table, indicating that interception substantially deeper than five feet would be necessary to provide meaningful reductions in the releases now occuring. In addition, free liquids present in the landfill and in drums which will continue to deteriorate and burst would be released and allowed to migrate vertically until the source was exhausted. The plan involving shallow (five foot) trenches was estimated to cost $35-40 million. Extensive and continous operation and maintanence (O & M) for the indefinite future would be necessary to maintain the collection system. It was estimated that for collection rates greater than 0.5 gallons per minute, economics would indicate construction of an on-site treatment plant. The problems associated with operating such a system for the indefinite future, meeting discharge requirements and handling occasional peak flows could be significant. In addition, there is no method for assuring the longterm operation of such a treatment system.

The continued release of hazardous wastes and hazardous substances with only negligible lateral interception and no vertical interception, the need for indefinite O & M when such cannot be assured, the potential for continued off-site impacts, and the entire "band-aid" type of approach that this, the most viable in-situ containment alternative entails is wholly inadequate to meet the objective of CERCLA and the directive of the NCP to provide a permanent remedy meeting or exceeding applicable or relevant and appropriate Federal public health and environmental requiremnts. As a result, closure in place was rejected as being incapable of containing wastes in the immediate vicinity of the site and unacceptable as a permanent source control remedy.

5.2) Alternative 7 - On Site Disposal:

The source areas (drum mound, main pit, and sludge mound) would be excavated. Solids would be treated and disposed in a landfill cell constructed on-site. Liquids would generally be incinerated. After completion, the landfill would be closed with a multi-layer cap and gas venting system. The Remedial Action (RA) would require about 18 months to complete at a present worth cost of $70 million (Table 2).

TABLE 2:

ALTERNATIVE NO. 7--ON-SITE DISPOSAL

| ITEM | COST |
|---|---|
| GENERAL | $ 1,800,000 |
| EXCAVATION, SEPARATION, SAMPLING | $12,979,000 |
| TREAT AND TRANSPORT DRUMMED WASTES | $ 5,450,000 |
| ON-SITE DISPOSAL | $12,789,000 |
| SITE RESTORATION | $ 196,000 |
| EVAPORATION/COLLECTION POND FOR SURFACE WATER | $ 280,000 |
| SURFACE WATER TRANSPORTATION, TREATMENT AND DISPOSAL | $ 5,403,000 |
| OTHER PROVISIONS | $ 249,000 |
| Construction Subtotal | $39,146,000 |
| Bid Contingencies (15%) | $ 5,872,000 |
| Scope Contingencies (20%) | $ 7,829,000 |
| Construction Total | $52,847,000 |
| Permitting and Legal (7%) | $ 3,699,000 |
| Services During Construction (10%) | $ 5,285,000 |
| Total Implementation Costs | $61,831,000 |
| Engineering Design Costs (10%) | $ 6,183,000 |
| TOTAL CAPITAL COSTS | $68,014,000 |
| OPERATION AND MAINTENANCE (Present Worth) | $ 1,690,000 |
| Bid Contingencies for Operation and Maintenance (15%) | $ 254,000 |
| Scope Contingencies for Operation and Maintenance (20%) | $ 338,000 |
| TOTAL OPERATION AND MAINTENANCE (PRESENT WORTH) | $ 2,282,000 |
| TOTAL PRESENT WORTH | $70,296,000 |

* Off-site incineration was assumed for cost-estimating purposes. This does not reflect a final decision to use off-site disposal facilities for any waste from the Hardage site.

5.3) Alternative 8 - On Site Incineration and Disposal:

The source areas would be excavated. Wastes would be incinerated in a kiln constructed on-site. Ash would still contain metals and, until proven otherwise through de-listing, would require disposal as a hazardous waste. Disposal would be in a landfill cell constructed on-site. This alternative would require four to eight years to implement at an estimated present worth cost of $326 million (Table 3).

5.4) Alternative 9 - On Site Incineration and Off Site Disposal:

The source areas would be excavated and wastes incinerated as above. The difference between this and Alternative 8 would be the off-site disposal of incinerator ash. This alternative would require four to eight years to implement at a cost of $374 million (Table 4). Future O & M for this source control remedy would be non-existent.

5.5) Alternative 10 - Off Site Disposal:

The source areas would be excavated; and wastes would be transported off-site to existing Treatment Storage and Disposal (TSD) facilities for landfilling, incineration, reuse/recycling, or other treatment as appropriate. This alternative could be implemented in about 2 years at an estimated present worth cost of $133 million (Table 5). As with alternative 9, O & M would be non-existent.

6.0) <u>SELECTED ALTERNATIVE:</u>

Alternative 7 (On-Site Disposal) is selected as the appropriate remedy for source control at the Hardage/Criner site. The process by which this alternative was chosen over the other three under consideration is outlined below.

6.1) Remedial alternative selection procedure:

EPA is required by Section 300.68(i) of the NCP to determine the appropriate extent of remedy by, "Selection of a cost-effective remedial alternative that effectively mitigates and minimizes threats to and provides adequate protection of public health and welfare and the environment". The NCP goes on to state that the selected remedy will attain or exceed applicable or relevant and appropria'e Federal environmental and public health requirements. EPA has c nsidered the cost, technology, reliability, administrative and other concerns in selecting Alternative 7 as the appropriate remedy, as documented below. These considerations have only been applied t alternatives meeting or exceeding the above noted requireme s.

TABLE 3:

ALTERNATIVE NO. 8--ON-SITE INCINERATION AND DISPOS

| ITEM | COST |
|---|---|
| GENERAL | $ 7,352,000 |
| EXCAVATION, SEPARATION, SAMPLING | $ 12,979,000 |
| ON-SITE INCINERATION OF WASTE FILL | $130,500,000 |
| TREAT AND TRANSPORT DRUMMED WASTES | $ 2,916,000 |
| ON-SITE DISPOSAL | $ 10,175,000 |
| SITE RESTORATION | $ 196,000 |
| EVAPORATION/COLLECTION POND FOR SURFACE WATER | $ 310,000 |
| SURFACE WATER TRANSPORTATION, TREATMENT AND DISPOSAL | $ 21,611,000 |
| OTHER PROVISIONS | $ 249,000 |
| Construction Subtotal | $186,288,000 |
| Bid Contingencies (15%) | $ 27,943,000 |
| Scope Contingencies (20%) | $ 37,258,000 |
| Construction Total | $251,489,000 |
| Permitting and Legal (7%) | $ 17,604,000 |
| Services During Construction (10%) | $ 25,149,000 |
| Total Implementation Costs | $294,242,000 |
| Engineering Design Costs (10%) | $ 29,424,000 |
| TOTAL CAPITAL COSTS | $323,666,000 |
| OPERATION AND MAINTENANCE (Present Worth) | $ 1,384,000 |
| Bid Contingencies for Operation and Maintenance (15%) | $ 208,000 |
| Scope Contingencies for Operation and Maintenance (20%) | $ 277,000 |
| TOTAL OPERATION ND MAINTENANCE COSTS (PRESENT WORTE | $ 1,869,000 |
| TOTAL PRESENT WOP H | $325,535,000 |

* Off-site incineration was assumed or cost-estimating purposes. This does not reflect a final dec ion to use off-site disposal facilities for any waste from the ardage site.

TABLE 4:

ALTERNATIVE NO. 9--ON-SITE INCINERATION/OFF-SITE DIS

| ITEM | COST |
|---|---|
| GENERAL | $ 7,928,00 |
| EXCAVATION, SEPARATION, SAMPLING | $ 12,979,00( |
| ON-SITE INCINERATION OF WASTE FILL-- Design, Construction and Operation | $130,500,00( |
| TREAT AND TRANSPORT DRUMMED WASTES | $ 3,788,00( |
| WASTE FILL REMOVAL TO OFF-SITE LANDFILL | $ 16,958,00C |
| OFF-SITE LANDFILL DISPOSAL CHARGES | $ 20,850,000 |
| SITE RESTORATION | $ 196,000 |
| EVAPORATION/COLLECTION POND FOR SURFACE WATER | $ 310,000 |
| SURFACE WATER TRANSPORTATION, TREATMENT AND DISPOSAL | $ 21,611,000 |
| Construction Subtotal | $215,120,000 |
| Bid Contingencies (15%) | $ 32,268,000 |
| Scope Contingencies (20%) | $ 43,024,000 |
| Construction Total | $290,412,000 |
| Permitting and Legal (7%) | $ 20,329,000 |
| Services During Construction (10%) | $ 29,041,000 |
| Total Implementation Costs | $339,782,000 |
| Engineering Design Costs (10%) | $ 33,978,000 |
| TOTAL CAPITAL COSTS | $373,760,000 |
| OPERATION AND MAINTENANCE (Present Worth) | $0 |
| Bid Contingencies for Operation and Maintenance (15%) | $0 |
| Scope Contingencies for Operation and Maintenance (20%) | $0 |
| TOTAL OPERATION AND MAINTENANCE COSTS (PRESENT WORTH) | $0 |
| TOTAL PRESENT WORTH | $373,760,000 |

TABLE 5:

ALTERNATIVE NO. 10--OFF-SITE DISPOSAL

| ITEM | COST |
|---|---|
| GENERAL | $ 2,538,0C |
| EXCAVATION, SEPARATION, SAMPLING | $ 12,979,0C |
| TREAT AND TRANSPORT DRUMMED WASTES | $ 7,584,00 |
| WASTE FILL REMOVAL TO OFF-SITE LANDFILL | $ 21,228,00 |
| OFF-SITE LANDFILL DISPOSAL CHARGES | $ 26,100,00 |
| SITE RESTORATION | $ 196,00( |
| EVAPORATION/COLLECTION POND FOR SURFACE WATER | $ 280,00C |
| SURFACE WATER TRANSPORTATION, TREATMENT AND DISPOSAL | $ 5,403,000 |
| Construction Subtotal | $ 76,308,000 |
| Bid Contingencies (15%) | $ 11,446,000 |
| Scope Contingencies (20%) | $ 15,262,000 |
| Construction Total | $103,016,000 |
| Permitting and Legal (7%) | $ 7,211,000 |
| Services During Construction (10%) | $ 10,302,000 |
| Total Implementation Costs | $120,529,000 |
| Engineering Design Costs (10%) | $ 12,053,000 |
| TOTAL CAPITAL COSTS | $132,582,000 |
| OPERATION AND MAINTENANCE (Present Worth) | $0 |
| Bid Contingencies for Operation and Maintenance (15%) | $0 |
| Scope Contingencies for Operation and Maintenance (20%) | $0 |
| TOTAL OPERATION AND MAINTENANCE COSTS (PRESENT WORTH) | $0 |
| TOTAL PRESENT WORTH | $'32,582,000 |

6.1.1) Comparison of on-site versus off-site remedial action alternatives:

Two alternatives, 7 and 8, involve on-site disposal of wastes excavated from source areas. Alternatives 9 and 10 entail complete off-site disposal of wastes. The alternatives 7 and 10 involve essentially the same operations (i.e. excavation with limited incineration and landfilling for the bulk of wastes), except that they are on and off-site variations of basically the same alternative. Similarly, alternatives 8 and 9 are basically on and off-site disposal options for residue from the on-site incinerator. Based on this point, the analysis below compares on-site to off-site disposal.

Cost: The cost of off-site landfilling and incineration alternatives exceed their on-site counterparts by 90% ($63 million) and 15% ($48 million) respectively.

Technology: The on and off-site options will be virtually identical in the treatment and disposal technologies employed. Control of the quality of work done under the on-site alternatives may be somewhat superior in this respect however, since these actions would be conducted under EPA oversight and off-site treatment or disposal would not.

Reliability: The off-site disposal options will provide reliability in preventing releases from this site, simply because wastes would not remain on-site. However, off-site disposal has the potential to increase health risks at other sites. It is not certain that any significant advantage exists in reliability of off-site over on-site disposal locations. The Hardage/Criner facility is in compliance with the siting requirements currently governing location of commercial disposal facilities. For this reason, any particular vulnerabilities which are present on the Hardage site would not necessarily be absent at off-site facilities.

Administrative: Each alternative will comply with RCRA Part 264 requirements, long-term objectives of CERCLA as amended, and all applicable or relevant and appropriate requirements for protection of public health and welfare and the environment. Since wastes will be left on-site, the remedial action will be reviewed every five years after it's completion, as required by the Superfund Amendments and Reauthorization Act of 1986 (SARA), to assure that the remedy is still protecting public health and the environment.

Other concerns: (Safety during implementation) Both on and off-site alternatives carry inherent risks during excavation. As discussed later, these impacts can be controlled. The primary difference between the on and off-site alternatives with respect to safety during implementation is the potential for accidents or spills during off-site transport of the wastes. For example, an estimated 11,000 loads would be required to transport the entire 180,000 cubic yards of waste off-site. For the 400 to 800 mile transport distance assumed in the FS, trucks carrying waste from the Hardage site would be on the road from four to eight million miles.

Consideration of the components of the four remedial action alternatives evaluated shows that the key difference is the presence of an on-site landfill under the two on-site alternatives. Information collected to date indicates that an adequate landfill cell could be constructed on-site and successfully maintained. The site meets RCRA Section 264.18 siting requirements for seismic stability and flooding potential. Due to the hazards and costs arising from off-site disposal and transport, clear and significant benefits should be present before off-site disposal is selected. Those benefits are not significant or certain in this case. While such benefits may exist in the off-site treatment of small to moderate quantities of specific wastes, organic liquids may be an example, off-site disposal for the entire waste quantity is not preferred over on-site management of wastes in this case. Therefore, the off-site alternatives are eliminated from consideration, and the on-site disposal alternatives (7 - On-site disposal; 8 - On-site incineration and disposal) will be carried on for further evaluation.

6.1.2) Comparison of the two on-site alternatives:

Cost: Alternative 7 would cost $39-109 million to implement, with the most likely cost being $70 million. Alternative 8 would cost $171-495 million, the likely figure being $326 million. Therefore, the benefits to be derived from incineration of all waste would come at a cost of 470% ($256 million) greater than landfilling.

Technology: Incineration is a key component of both alternatives 7 and 8. Since some wastes are liquids which cannot be landfilled, the decision to incinerate organic liquids is appropriate.

Incineration of all wastes will have the net benefit of destroying virtually all organic materials. Even with incineration however, heavy metals will still be present in the residue. These materials simply cannot be destroyed. The mobility can be reduced by treating the waste to reduce it's acidity; this would be done under either alternative.

Reliability: By incineration, virtually all organics are destroyed, leaving an ash with varying contents of heavy metals requiring stabilization and disposal as a "characteristic" hazardous waste. The landfilling alternative, with limited incineration, removes only the free organic liquids with the greatest potential for penetrating a landfill liner and moving into the environment.

Landfilling and incineration of liquids are established technologies, with a demonstrated ability to perform under similar conditions. Incineration of soils contaminated by a heterogenous mixture of wastes, while feasible, has not yet been attempted on a scale such as would be required for complete incineration at the Hardage site.

Administrative: Both alternatives would meet all aplicable or relevant and appropriate requirements for protection of public health and welfare and the environment. Since wastes would be left on-site, the remedial actions would have to be reviewed every five years as required under Section 121 of SARA.

Other concerns: (time to implement) Landfilling can be accomplished in 12 to 18 months. Incineration will take four to eight years.

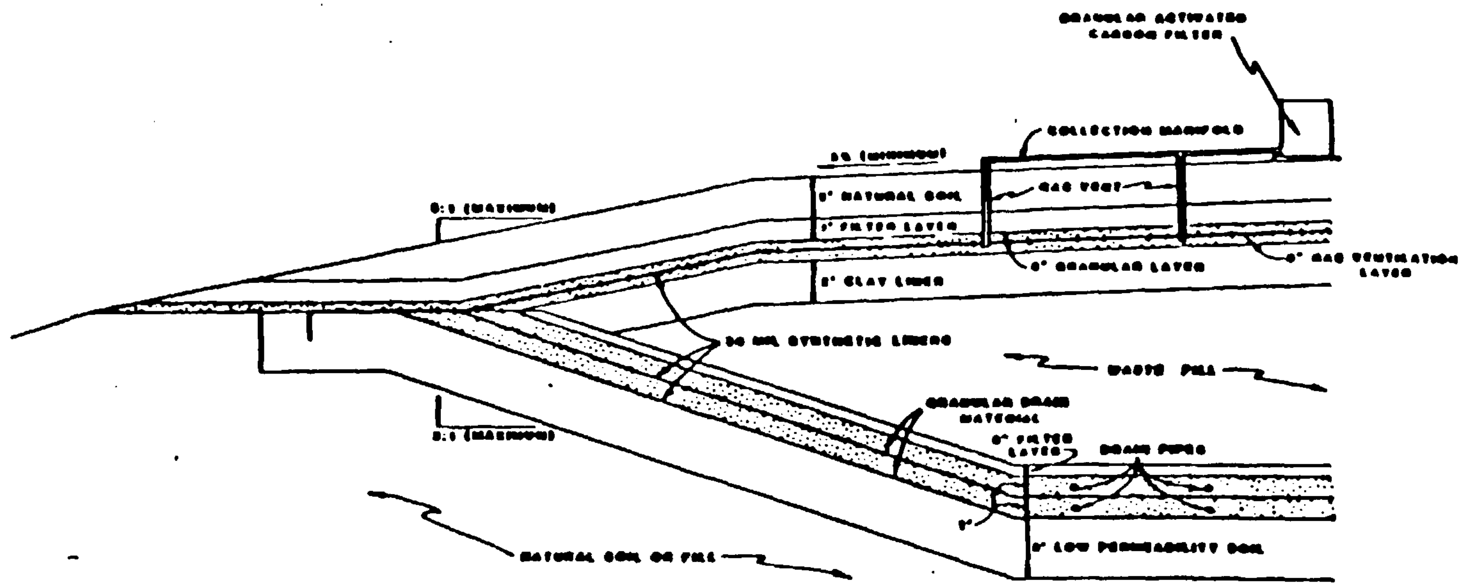
Based on the factors considered above, Alternative 7 (On-site landfill with liquids incineration) is selected as the appropriate remedy for the Hardage/Criner site. This alternative will provide a degree of protection to public health and welfare and the environment similar to that which could be achieved with complete incineration. This remedy can also be carried out in a shorter time using proven technologies which are currently in wide-spread application.

6.2) Detailed Description of the Recommended Alternative:

The following is a general sequence of operations and construction activities required to implement on-site disposal for a source control remedy at the Hardage/Criner site. The timing and specifications will be developed in detail during the Remedial Design (RD) phase of response.

A landfill cell will be constructed to meet the minimum technology requirements for hazardous waste landfills as set forth in RCRA Section 264.301. The key feature of such a landfill cell is a double liner system with interior leachate monitoring and collection (Figure 6). The landfill will be constructed above grade on the high ground west and north of the present source areas, as indicated in the FS. If at all possible, construction of the landfill cell over significant residual contamination will be avoided. The exact siting of the landfill cell will be based on the results of surface soil sampling during the second unit RI, consideration of topography and hydrology of the site, and possibly additional geotechnical data collected during the RD. Sufficient land is available on which to site a landfill cell.

The sludge mound, main pit, and drum mound will be excavated. This represents a volume of approximately 180,000 cubic yards, and includes in excess of 10,000 to 20,000 unemptied drums. For this operable unit, the vertical extent of waste excavation will be to the upper surface of undisturbed bedrock (see Section 6.3 - Clean-up levels).




NOT TO SCALE



**FIGURE 6:**

Typical cross-section of

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AR001875

After waste excavation, treatment, and disposal (described below), the empty waste pits and bedrock now underlying the waste piles will still remain. This upper bedrock surface is believed to be saturated with waste seepage to an unknown depth. Such residual contamination will generally not be removed during the source control remedial action, since the appropriate extent of vertical excavation cannot yet be defined. In order to prevent contamination of surface runoff waters and to eliminate direct contact exposure hazards from open areas of residual waste, it will be necessary to construct a protective temporary cap over the former source areas. This temporary cap will serve the dual purposes of preventing direct rainfall from leaching the contaminated bedrock and eliminating direct contact hazards. The cap will be constructed so as to achieve these goals and at the same time be of a design to allow upgrading to meet relevant and appropriate RCRA closure standards should it be determined by the second operable unit RI/FS that closure in-place is an appropriate permanent remedy for residual contamination beneath the former source areas. Considering the relative times required for design of the source control remedy and conduct of the management of migration RI/FS, it is possible that final clean-up levels will have been developed for the site prior to waste excavation. If such clean-up levels are available, the interim cap would be unnecessary and remedial action for residual contamination in the bedrock beneath the former source areas can proceed directly from excavation of the source areas.

Since wastes excavated in the source areas will range in consistency from dry solids to relatively pure liquids, and since the appropriate means of waste treatment and disposal is in large part determined by the physical consistency of the material, it is clear that criteria will have to be developed during the RD which allow segregation of: liquids for incineration or other treatment, solids whose moisture content is appropriate for landfilling, and solids requiring moisture reduction prior to landfilling.

Liquids will be defined by the relevant and appropriate RCRA testing procedures (currently the Paint Filter Test) which are effective at the time the remedial design is approved. Liquds will be segragated based on their chemical make-up (i.e. organic versus inorganic as described in the FS). The RD will develop criteria for making this distinction.

Solids, as defined by testing procedures noted in the above paragraph, will be handled in a manner based on decisions made in a moisture content evaluation, described below under Section 6.2.3. Based on the criteria developed there, wastes will have to have to fall below an upper limit on moisture content, after treatment, before they can be disposed in the landfill, provided other requirements, such as land disposal bans, do not preclude their placement in the landfill. Based on the determinations and criteria from the RD, the wastes will be treated and disposed as indicated in the general schematic shown in Figure 7. Discussion of waste treatment and disposal is provided below.

Treatment of organic liquids: These liquids will be incinerated. Based on the economics of the volume of materials encountered, this would be done either at an off-site facility or on-site with a portable or modular incinerator.

Treatment of inorganic liquids: Based on the economics of the volume and character of the liquids encountered, treatment and disposal may be done either on or off-site. On site treatment would generally be through physiochemical methods capable of removing both organics and metals, to allow discharge under an NPDES permit or transport to a publicly owned treatment works. If off-site treatment is selected, either deep well injection or treatment at a commercial facility would be available.

Treatment of Solids: Solids will ultimately be placed in the landfill cell constructed on-site. Prior to disposal, the wastes will be subjected to treatment aimed at reducing their toxicity and mobility. Since a large volume of contaminated soil is present, significant volume reduction would not be possible. Such treatment may include addition of materials to stabilize the fill or physiochemical treatment designed to remove or alter specific hazardous constituents or classes of compounds. Treatment technologies identified are:

- chemical neutralization (pH adjustment),
- solidification by addition of lime, cement, fly ash, or other proprietary agents,
- reduction of liquid content,
- chemical oxidation or reduction, and
- air stripping to remove volatiles.

Other alternative treatment technologies identified during the remedial design will also be considered for application, and those technologies showing promise for the specific wastes and situations at the Bardage site will be evaluated further through bench tests or pilot studies as appropriate

During the remedial design, an evaluation including bench testing will be conducted to determine an appropriate upper limit on the moisture content of fill which could be placed in the on-site landfill. This evaluation will consider the potential composition of pore fluids in the waste, the reaction of various soil/fluid combinations under the type of triaxial stresses to be expected within the

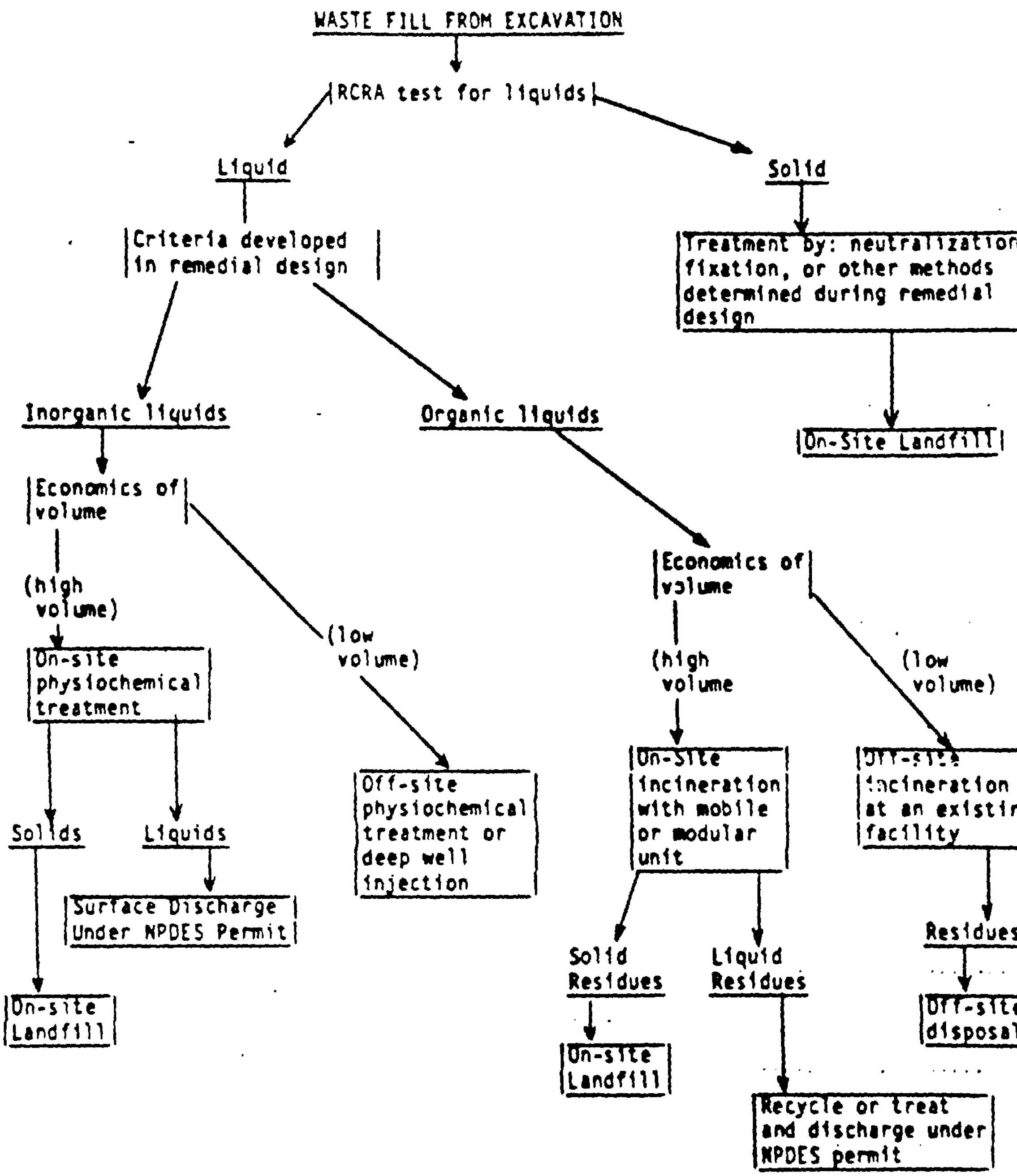


FIGURE 7: AR001878

Treatment schematic for alternative number 7 - on-site landfill with liquids incineration landfill, the potential for long and short-term leachate generation, and the effects of such leachate on various liner systems proposed for the landfill cell. Based on the results of this evaluation, an upper limit will be imposed on the moisture content of wastes which can be disposed in the landfill. Wastes placed in the landfill will in no case be of the type which:

a) would be classified as "liquids" by applicable or relevant and appropriate testing procedures pursuant to the RCRA prohibition on the disposal of liquids in landfills; or

b) are the subject of any land disposal bans under the Hazardous and Solid Waste Amendments to RCRA or the Toxic Substances Control Act which are determined to be applicable or relevant and appropriate.

Treatment technologies will be further refined during the RD phase; and additional design data may be required. The variability of wastes present in the source areas precludes any extensive characterization of wastes prior to excavation. For this reason, final determinations on appropriate treatment will in some cases have to be made during the RA itself.

6.3) Clean-up Levels for the Source Control Operable Unit:

Selection of clean-up levels will be a concern of the second operable unit (Management of Migration). Ultimately, clean-up levels will have to be selected for the base of the pits and for surface soils on-site. In the pit areas, the criteria will generally include potential for migration of metals and organics which have already migrated out of the pits. The surface soil criteria will focus on metals, PCBs, and pesticides due to their persistence in the environment, direct contact exposure hazards, and potential to contaminate surface runoff.

The Source Control operable unit deals exclusively with the concentrated pits and piles of wastes. In this case, selections of compounds of concern and selection of clean-up levels based on soil concentrations of these compounds is not appropriate. The criteria to be used for determining the extent of clean-up will be the surface of undisturbed bedrock. If, at that point in the RA, additional data from the second operable un[illegible] RI/FS or the Source Control RD has allowed determination of a f[illegible]al clean-up level, then excavation, in-situ treatment, or permanent capping may be implemented for the residual contaminants. If such data is not available, a temporary cap will be installed [illegible]ver the excavated areas pending second operable unit remedy de[illegible]rmination.

6.4) Health and Safety Concerns During Implementation

Excavation of the waste piles and pits will pose hazards to workers via air and direct contact in addition to the physical hazards normally associated with such construction. In many cases the waste excavation and handling will have to be conducted under Level B protection (containerized air and protective clothing) to mimize hazards to the workers. Air release of volatile organics will likely increase during waste excavation. Continuous monitoring of air around working areas, at the site perimeter, and near offsite homes will allow identification of health threats to off-site residents and prevent problems from going undetected. Dust and vapor suppression measures, maintenance of a small working face of exposed waste, and possible use of a temporary structure over the excavation will help to minimize air releases.

Runoff retention structures and emergency holding ponds will be used to prevent chronic or sudden releases during construction.

7.0) COMPLIANCE OF REMEDIAL ACTION WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR PROTECTION OF PUBLIC HEALTH AND THE ENVIRONMENT

Section 300.68(i) of the NCP directs that EPA will, except in narrow cases such as "fund-balancing", select a remedy that "attains or exceeds applicable or relevant and appropriate Federal public health and environmental requirements that have been identified for the specific site." These applicable or relevant and appropriate requirements (hereinafter "Requirements") are discussed in an October 2, 1985 memorandum from Winston Porter, Assistant Administrator for EPA's Office of Solid Waste and Emergency Response, "CERCLA Compliance with Other Environmental Statutes", which is set forth in the preamble to the NCP at 50 Fed. Reg. 47912, 47946 (November 20, 1985).

The principal requirements and policies to be considered during conduct of the RA will be as follows:

7.1) RCRA Subtitle C Permit Requirements, 40 CFR Part 264:

While not deemed applicable to the site since it closed prior to November 19, 1980, these requirements are considered to be relevant and appropriate to this CERCLA response action to the extent indicated below. Leaving engineering considerations aside, the Part 264 permit requirements are considered appropriate rather than the Part 265 interim status requirements. The facility closed prior to the effective date of interim status, rather than attempt to comply with these standards. Royal Hardage notified EPA of hazardous waste activity under RCRA in August 1980, but withdrew the notification in November 1980 and did not file Part A of the RCRA permit application, most likely because the site could not have met those standards without bankrupting the facility. As indicated previously, wastes were disposed haphazardly in unlined pits and the treatment, storage, and disposal of hazardous wastes at the facility as far below the standards required for interim status facilities. Indeed, EPA filed a lawsuit seeking clean up and closure of the facility under RCRA, Section 7003 in U.S. District Court in Oklahoma City on September 8, 1980. EPA has conclusive and demonstrable evidence of releases of hazardous wastes and hazardous substances from the disposal units of the Hardage site. Given this situation, the most appropriate Federal environmental requirements to apply to the source control action, which is consistent with and forms a substantial increment of a permanent site remedy, would be the Part 264 requirements, applicable to new facilities, along with their more stringent closure requirements.

Additionally, EPA believes that the physical nature of the site, it's hydrology, and underlying geologic conditions dictate that the waste materials not be left in-place. Accordingly, it is clear that the Part 264 permitting and closure requirements should be applied to the construction and closure of new disposal units necessary for this facility.

Finally, it should be noted that, as the preamble to the NCP states, "... although the Subtitle C regulations differ as to whether a hazardous waste facility has a RCRA permit (40 CFR Part 264) or is operating under interim status (40 CFR Part 265), remedies will generally have to be consistent with the more stringent Part 264 standards, even though a permitted facility is not involved. The Part 264 standards represent the ultimate RCRA compliance standards and are consistent with CERCLA's goals of long term protection of public health and welfare and environment." 50 Fed Reg at 47918.

7.1.1) Subpart B - Siting Requirements:

This will govern placement of the landfill cell on-site. The principal concerns stated in this subpart are seismic stability and flooding potential. Neither factor appears to be a major concern at the Hardage site; therefore, compliance does not seem to pose problems.

7.1.2) Subpart F - Groundwater:

This subpart will determine the extent to which the on-site landfill will be monitored. It will have a much wider application under the second operable unit.

7.1.3) Subpart G - Closure and Post-Closure:

These standards will apply to closure of the landfill cell(s) after completion of the source control RA. The remedy will comply with this subpart.

7.1.4) Subpart K - Surface Impoundments:

This will apply to any temporary impoundments constructed during the RA that treat, store,or dispose hazardous wastes. Impoundments will be lined, opearted, closed, and if necessary monitored in compliance with this subpart.

7.1.5) Subpart N - Landfills:

This subpart will govern construction and operation of the landfill cell. The landfill will meet requirements set forth for new landfills.

7.2) Toxic Substances Control Act:

This would come into application if PCBs are encountered at levels greater than 50 ppm, since such materials are banned from land disposal. In that case, alternative treatment would be required and implemented in order to comply with the Act.

7.3) EPA CERCLA Off-Site Policy (memorandum dated May 5, 1985; "Procedures for Planning and Implementing Off-site Response Actions"):

This policy will determine which TSD facilities are eligible for receipt of hazardous substances from the site. The policy generally requires a facility to be permitted and have no significant RCRA violations or conditions affecting it's satisfactory operation. Prior to disposing or authorizing disposal of wastes from this site the Region will contact the State in which the facility is located, review the facility's record of operation, and if appropriate contact other Regional offices of EPA where the facilities may be located to evaluate compliance with this policy. No wastes will be disposed at any site not meeting the criteria set forth in the policy.

7.4) Occupational Safety and Health Standards (29 CFR Part 1910):

These standards will be applied during remedial actions to protect workers from exposure to hazardous substances and other physical hazards associated with implementation of the RA. Methods for assuring the safety of workers involved in the RA will be devloped and described in a "Site Safety Plan" developed as part of the Remedial Design.

7.4) Hazardous and Solid Waste Amendments to RCRA of 1984:

The Hazardous and Solid Waste Amendments to RCRA of November 1984 (HSWA), 42 U.S.C. 6901 et seq. contain provisions setting several statutory dates for banning land disposal of hazardous wastes The provisions discussed here are RCRA Section 3004 (d)(e) and (g), due to the possible intersection of their statutory deadlines with the construction schedule for a source control remedy at the Hardage site.

The HSWA land disposal amendments are in fact not yet applicable or effective Federal requirements with respect to CERCLA Section 104 or 106 response actions, since their implementation dates are still some time off in the future. The bans found in subsection (g) are to be implemented during three periods over 21 months for 1/3, 2/3, and finally all of the RCRA subtitle C "listed" hazardous wastes commencing August 8, 1988, as determined by EPA. Those determinations will be made by rulemaking. See 50 Fed. Reg. 19300 (May 28, 1986) for the list of wastes to be considered.

The statutory ban on the "California List" wastes and solvents in subsections (d) and (e) and the prospective bans laws of subsection (g) are not considered relevant and appropriate at this time, since their applicability to CERCLA waste disposal is in the future. The effect of the bans in subsection (g) on the remedy is speculative at best, since EPA is required to engage in rulemaking for methods of land disposal and pretreatment for such disposal, 42 U.S.C. 6924 (g)(5) and (m). Futhermore, it must be emphasized that CERCLA requires the selection of cost-effective remedies and does not require EPA to implement standards that are not in effect.

During the course of remedial action and construction, EPA intends to further review the effect of land disposal bans on waste disposal at the site and the issues of how such laws will be implemented should they intersect the construction schedule. Additionally, bench tests and/or pilot studies may be performed with respect to pre-treatment methods for solvents and other organics potentially impacted by such bans.

8.0) OPERATION AND MAINTENANCE

The on-site landfill will require little routine operation and maintenance (O & M). Monitoring of the interior leachate detection system will be required, as will periodic inspections of the cap and monitoring of gases leaving the venting system. Development and routine sampling of a groundwater monitoring network will also be necessary for 30 years, at which time the need for additional monitoring will be reevaluated.

To provide a contingency in project cost estimates, it was assumed that at 30 years after construction replacement of the landfill liner and cap might be necessary. The cost is reflected in the present worth cost estimate of $70 million. Operation and maintanence costs on a present worth basis are estimated as $2,282,000 in 1985 dollars.

9.0) COMPLIANCE OF SOURCE CONTROL REMEDIAL ACTION WITH SECTION 121 OF THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 (SARA) TO THE MAXIMUM EXTENT PRACTICABLE

9.1) Basic Certification:

The selected remedy will comply with Section 121 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by SARA, including the cleanup standards thereof, to the maximum extent practicable. The selected remedy is considered to be cost effective and protective of human health and the environment as well, in accordance with the NCP.

9.2) Permanent Solutions and Technologies

In selecting this remedy, EPA has considered a full range of alternatives and solutions and alternative treatment technologies that will result in a permanent and significant decrease in toxicity, mobility, or volume of the hazardous substances present. In conducting its assessments of remedial alternatives and treatment technologies, EPA has considered:

1) The long term uncertainties of land disposal;

2) goals and requirements of the Solid Waste Disposal Act ("RCRA");

3) persistence, toxicity, mobility and bioaccumulation potential of the wastes;

4) short and long term potential for adverse human health effects;

5) long term maintenance costs of the remedy;

6) potential for future remedial actions costs if the remedy fails;

7) potential threat to human health and the environment from the excavation, transportation, and redisposal, or containment of hazardous substances.

9.3) Remedy Analysis:

The selected remedy is a remedy for the first operable unit of remediation - source control. It is a significant part of overall remediation at the Hardage site and is consistent with a permanent remedy for the site. The second operable unit, "management of migration", is now under development.

This remedy will employ treatment through incineration of all free liquid organics in the estimated 175,000 cubic yards of waste fill, as well as the more than 18,000 estimated drums of waste buried on-site. Remaining waste fill and inorganic solid drum contents will be treated through stabilization measures prior to redisposal in a double lined on-site RCRA compliant landfill cell. In carrying out these measures, EPA will be permanently and significantly reducing the volume, toxicity, and mobility of the hazardous substances present at the Hardage site. Further, EPA will avoid in large measure the potential dangers and uncertainties of transport and disposal off-site, with its on-site approach for the bulk of wastes. EPA requires that this source control remedy be reviewed not less than every five years to assure that human health and the environment are being protected.

As noted previously, in Section 7 herein, EPA has scrupulously considered the applicable or relevant and appropriate federal requirements for protection of public health and the environment in accordance with the NCP. EPA has also looked into the issue of applicable or relevant and appropriate state environmental laws and has determined that the "RCRA analogous" regulatory requirements of the Oklahoma Controlled Industrial Waste Disposal Act, as amended, authorized by EPA under RCRA to operate in lieu of the EPA regulations, are met or exceeded by the selected remedy. In a nutshell, EPA has complied with the SARA Section 121 cleanup standards to the maximum extent practicable.

## 10.0) OTHER OPERABLE UNITS

EPA's response actions on the Hardage/Criner have been divided into two operable units: Source Control (the remedy discussed in this document) and Management of Migration (also referred to as the groundwater/off-site operable unit).

The source control response is limited to the source areas of the site (sludge mound, main pit, and drum mound). The bases of the main pit and southern pit (beneath the sludge mound) at approximate elevations of 1109 and 1093 feet MSL respectively form the lower bound of the source areas. The lateral bounds of the source areas are described by the base of the slopes on the north, south, and west faces of the waste piles and pits, and as the lateral extent of the excavated pits on those sides of the source areas where wastes and cover have been backfilled to ground level.

The management of migration RI/FS will include the following:

- Definition of the extent and levels of contamination present in soils and rock outside the source area;
- determination of the extent and fate of groundwater contamination in the alluvium of North Criner Creek and the feasibility and need for remedial actions in the alluvial valley;

- determination of permanent surface clean-up levels on-site to prevent or minimize further degradation of potential surface and ground water supplies, direct contact hazards to the public, and other long term hazards.

## 11.0) ENFORCEMENT

### 11.1) Hardage I:

In 1979, EPA inspections of the site indicated poor waste management practices posing potential threats to public health and welfare and the environment. In September 1980, the U.S. Department of Justice (DOJ) filed a complaint on behalf of EPA in U.S. District Court in Oklahoma City, Oklahoma. The complaint alleged violations of Section 7003 of RCRA and sought proper cleanup and closure of the site. The facility had ceased operations in early November 1980, before RCRA Interim Status Standards came into effect.

In 1982, DOJ and EPA amended the existing complaint against the facility owner and operator Royal Hardage. The complaint was changed to include allegations and requested relief under Sections 106 and 107 of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). In December 1982, the Court found that the site posed an imminent and substantial endangerment to public health and welfare and the environment as defined by CERCLA Section 106 and RCRA Section 7003. In August 1983, the Court granted a partial judgment for over $211,000 in response costs, which EPA had incurred through 1982, against Royal Hardage.

Hardage filed for bankruptcy in 1983 and again in 1985, and EPA has never recovered its partial judgment.

### 11.2) Hardage II

EPA compiled available records from the sites operations including daily and monthly site logs of wastes received, waste manifests, and disposal plans and records filed with the State of Oklahoma by generators and transporters of waste to the site.

As a result nu erous Potentially Responsible Parties (PRPs) were identified. ) December 1984, EPA mailed letters to 289 of these PRPs requesti information about their waste disposal at the Hardage site der authority of Section 104(e) of CERCLA and Section 3007 of RCRA 1 notifying the PRPs of their potential liability for site clea p. As further information was gained, information request and nc ice letters were sent to additional PRPs identified. At the presen time, over 400 PRPs have been identified. Various PRPs have gon out of business or cannot be located; therefore, approximately 10 have been contacted. A number of these parties, have organize nto the Hardage Steering Committee (HSC). The HSC has met with t \ and OSDH on numerous occasions since EPA's first PRP meeting concer ng the site in January 1985.

Since the FS was on going at the time the PRPs were notified and CERCLA progam policy previously did not allow PRP conduct of RI/FS studies without a signed agreement to also implement the EPA selected remedy, the PRPs were not involved in preparation of the FS. In May 1985, EPA released the DSR documenting 1984 site investigations: and HSC also obtained all EPA files on the site. The HSC has retained Dames & Moore and more recently ERM-Southwest to provide technical support in their dealings with EPA.

In July 1985 the Court administratively closed the 1980 case against Hardage, providing that the U.S. could re-open the case for the purpose of seeking appropriate relief until April 1, 1986, at which time the case would otherwise be dismissed. DOJ, on behalf of EPA, filed a motion on March 27, 1986, to amend the existing complaint and add generators and transporters to the existing case. The Court ultimately denied the motion and dismissed the case, providing that Royal Hardage could be named for limited purposes in a subsequent case.

On June 25, 1986, DOJ filed a new complaint naming 36 generators and transporters of waste at the site. The complaint asks for performance of the EPA selected source control remedy, maintenance of site security, conduct of a RI/FS for the management of migration operable unit and any subsequent EPA selected remedy, and recovery of EPAs' past and future response costs. A status conference was held on September 3, 1986, and a second status conference has been set for January 7, 1987.

## 12.0) COMMUNITY INVOLVEMENT

Due to the large number of PRPs for this site, the majority of meetings, comments on the FS, and other external communication has been with these parties, However, attention has been given to the concerns of near site residents and other interested parties.

When the draft FS was completed on February 20, 1986, a press release was issued announcing this fact, copies of the FS were placed in repositories, and a copy was provided directly to the Hardage Steering Committee. The public comment period was from March 10-April 15, 1986. A public meeting was held in Chickasha, Oklahoma to answer questions and receive comments on the FS on March 20. The response to questions, comments, and concerns raised during this period is contained in the Responsiveness Summary, Appendix C.

## 13.0 REFERENCES


$CH_2M$ Hill 1985
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APPENDIX A

CHRONOLOGY OF EPA SITE INVESTIGATIONS

PRIOR TO 1984

## APPENDIX A

EPA Sampling and Inspections of Hardage/Criner prior to 1984:

June 27, 1979

Inspector: Ralph Hawkins (EPA-Ada Branch) accompanied by Oklahoma State and County Health Department personnel

Purpose: NESHAPS inspection due to asbestos disposal

Result: Recommended Sampling of site

Documentation: 7/3/79 memo, Hawkins to Charles Gazda (EPA-Dallas)

August 15, 1979

Inspector: S.C. Yin (EPA - Ada Branch) with other EPA and State Health Department personnel

Purpose: Obtain samples and inspect site

Result: Nine soil, water, and waste samples taken, analyzed for metals and organics; photos taken

Documentation: 9/10/79 memo, Yin to Charles Gazda (EPA-Dallas) 10/26/79 memo William Langley (EPA-Houston Lab) to Oscar Ramirez (EPA-Dallas) transmitting analytical results.

August 14, 1980

Inspector: Thomas Smith of Ecology & Environment (FIT) for EPA

Purpose: Off-Site sampling

Result: Three samples taken from off-site drainage pathways; analyzed for metals and organis; photos taken

Documentation: 8/21/80 memo T. Smith to Charles Gazda (EPA-Dallas); 9/23/80 memo William Langley (EPA-Houston Lab) to William Librizzi (EPA-Dallas) transmitting analytical results

October 1, 1980

Inspector: S.C. Yin (EPA-Ada Branch) with FIT personnel

Purpose: Off-site sampling

Result: Thirteen (13) samples taken from off-site drainage and domestic water wells, analysis for metals and organics, photos taken

| | |
|---|---|
| Documentation: | 10/23/80 memo, Yin to William Librizzi (EPA-Dallas); 10/15/80 memo William Langley (EPA-Houston Lab) to Librizzi transmitting analytical results |

March 23 - April 8, 1982

| | |
|---|---|
| Inspector: | Imre Sekelyhidi (FIT) personnel and other FIT employees for EPA |
| Purpose: | Detailed on and off-site sampling of the site |
| Result: | 3/23-24/82, 29 samples collected;<br>3/30-4/1/82, 6 domestic wells sampled<br>3/30-4/2/82, 10 monitoring wells drilled, by Shepard Testing and Engineering Co., Inc. of Norman, Oklahoma at locations directed by Jerry Thornhill (Hydrogeologist, EPA-Ada Branch)<br>soil borings and monitoring well samples collected from each new monitoring well |

August 16, 1982

| | |
|---|---|
| Inspector: | Ecology & Environment (FIT) for EPA |
| Purpose: | Second sampling round for the wells drilled by FIT in March 1982 |
| Result: | 10 groundwater samples collected |

APPENDIX B

LIST OF POTENTIALLY RESPONSIBLE PARTIES

IDENTIFIED FOR THE HARDAGE/CRINER SITE

AL000189?

...AN CORP.
710 A BETTER SANITATION
711 ABLE UNIFORM RENTAL
712 ACME FENCE
713 ADVANCE PACKAGING
714 AGLAND, INCORPORATED
715 ALTEC SOUND PRODUCTS DIVISION
716 AMERICAN AIRLINES, INCORPORATED
717 AMERICAN DISPOSAL SERVICE
718 AMERICAN FARM LINES, INCORPORATED
719 AMERICAN FURNITURE STRIPPING
720 AMERICAN TRAILERS, INCORPORATED
721 AMOCO PRODUCTION COMPANY & RESEARCH
722 A-ONE BIT & TOOL COMPANY
723 ATLANTIC RICHFIELD COMPANY
724 ARKANSAS BEST CORPORATION
725 ARROW TANK TRUCK, INCORPORATED
726 ARTHUR G. McGEE AND COMPANY
727 ASHLAND CHEMICAL COMPANY
728 BALON CORPORATION
729 BEAUTY CRAFT TILE OF THE SOUTHWEST, INC.
731 BINNEY I. SMITH, INCORPORATED
732 BOB MOORE OILWELL SERVICE
733 BORDEN CHEMICAL DIVISION
734 BRITTAIN BROTHERS (NAPA)
735 BROADWAY MACHINE & MOTOR SUPPLY
736 BROWN AND ROOT, INCORPORATED
737 BROWNING-FERRIS INDUSTRIES, INCORPORATED
738 B.S. & S. ENGINEERING COMPANY
739 CAPITOL GREASE COMPANY
740 CATO OIL & GREASE
741 C.E. NATCO
742 CHARLES MACHINE WORKS, INCORPORATED
743 CHROM ALLOY DIVISION
744 CHROMIUM PLATING COMPANY
745 CIMARRON MANUFACTURING COMPANY
746 CITIES SERVICE OIL COMPANY
747 CITY SERVICE
748 CITY OF NORMAN
749 CLAYTON PLATING COMPANY
750 CLYDE'S CARBURETOR SERVICE
751 CMI CORPORATION
752 COMPETITION AUTOMOTIVE
753 CONOCO, INCORPORATED
754 CONSOLIDATED CLEANING SERVICE COMPANY
755 CONTAINER CORPORATION OF AMERICA
756 CORE LABORATORIES
757 COUNTY HOME MEAT COMPANY
758 CRANE CARRIER CORPORATION
759 GROSBY GROUP, McKISSICK PRODUCTS DIV.
760 CROWL MACHINE & HEAT TREATING
761 CROWN TRANSPORT COMPANY
762 DAL-WORTH INDUSTRY, INCORPORATED
763 DAYTON TIRE & RUBBER COMPANY
764 DEL PAINT MANUFACTURING
765 DELTA FAUCET COMPANY
766 DELTA TRANSMISSION

THIS LIST REPRESENTS EPA'S PRELIMINARY FINDINGS ON THE IDENTITIES OF POTENTIALLY RESPONSIBLE PARTIES. INCLUSION ON THIS LIST DOES NOT CONSTITUTE A FINAL DETEMINATION CONCERNING THE LIABILITY OF ANY PARTY FOR THE HAZARD OR CONTAMINATION AT THE HARDAGE SITE

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768 DESOTA, INCORPORATED
769 DESOTA, INCORPORATED
770 DOUBLE EAGLE REFINING LUBRICANTS, INC.
771 DOVER CORPORATION
772 DOW CHEMICAL COMPANY
773 DOWNTOWN AIRPARK, INCORPORATED
774 DRILLERS ENGINE & SUPPLY
775 DURA-CHROME INDUSTRY
776 EASON & SMITH, WASTE HAULERS
777 EASON ENTERPRISES
778 EASON OIL
779 E.I. DUPONT DE NEMOURS
780 ELTEX CHEMICAL AND SUPPLY COMPANY
781 ENGINEERING ENTERPRISES
782 EQUIPMENT RENEWAL COMPANY
783 ERNEST ST. CLAIR
784 EUREKA TOOL COMPANY
785 EVAN'S ELECTRIC SERVICE CENTER
786 FAA AERONAUTICAL CENTER
787 FIBERCAST CORPORATION
788 FINE CANDY COMPANY
789 FIRST NATIONAL MANAGEMENT CORPORATION
790 FLINT STEEL CORPORATION
791 FORD GLASS PLANT
792 FOSTER FEED & SEED
793 FOSTER SEPTIC TANK CLEANING
794 FRED JONES MANUFACTURING
795 FREUHAUF CORPORATION
796 GARDNER-DENVER COMPANY
797 GENERAL ELECTRIC
798 GENERAL ELECTRIC
799 GENERAL TIRE & RUBBER
800 GEOPHYSICAL RESEARCH
801 GLIDDEN COATINGS & RESINS COMPANY
802 GLOW-LITE DIVISION OF DUTCH BOY, INC.
803 GOODYEAR TIRE & RUBBER COMPANY
804 GOVERNAIR CORPORATION
805 GROENDYKE TRANSPORT, INCORPORATED
806 HALLIBURTON SERVICES
807 ROYAL M. HARDAGE
808 HART INDUSTRIAL DISPOSAL
809 HATHAWAY INDUSTRIES
810 HELM & WEAVER
811 HERMETIC SWITCH, INCORPORATED
812 HOLLEY CARBURETOR
813 INDUSTRIAL UNIFORM
814 INDUSTRIAL DISPOSAL SUPPLY, INCORPORATED
815 INTERNATIONAL CRYSTAL MANUFACTURING
816 JOHN ZINK COMPANY
817 JONES-BLAIR PAINT COMPANY
818 KELSEY-HAYES
819 KELTRONICS CORPORATION
820 KERR McGEE, PRESIDENT
821 KIMBALL CHEMICAL COMPANY
822 KOBE INCORPORATED
823 KOCO TV
824 LAWT J PLATING COMPANY
825 LEAR SIEGLER, INCORPORATED

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826 L. & S. BEARING COMPANY
827 LEEWAY MOTOR FREIGHT(C.L. MOTOR FREIGHT)
829 MAREMONT CORPORATION
830 MASTER MOTORS
831 MATERIALS RECOVERY ENTERPRISES
832 McDONNELL DOUGLAS
833 McKESSON CHEMICAL COMPANY
834 MANUFACTURING MERCURY MARINE
835 METROPLEX SANITATION
836 MIKE MONRONEY AERONAUTICAL
837 MOBIL CHEMICAL COMPANY
838 NAMEPLATES, INCORPORATED
839 NATIONAL CAN CORPORATION
840 NATIONAL PACKAGING COMPANY
841 NELSON ELECTRIC COMPANY
842 NEWSPAPER PRINTING CORPORATION
843 NICKLES MACHINE CORPORATION
844 NORDHAM, INCORPORATED
845 NORTHROP WORLDWIDE AIRCRAFT SERVICE INC.
846 NU CHROME PLATING
847 O'BRIEN PAINT CORPORATION
848 OCCIDENTAL CHEMICAL
849 OKLAHOMA CITY DISPOSAL
850 OKLAHOMA GAS & ELECTRIC
851 OKLAHOMA CITY COUNTY HEALTH DEPARTMENT
852 OKLAHOMA DEPARTMENT OF AGRICULTURE
853 OKLAHOMA DEPARTMENT OF CORRECTION
854 OKLAHOMA STATE DEPARTMENT OF HEALTH
855 O.K. PUBLISHING COMPANY
856 OKLAHOMA MACHINE MANUFACTURING
857 O.K. NATIONAL STOCKYARDS COMPANY
858 O.K. NATURAL GAS COMPANY
859 O.K. TANK SERVICE, INCORPORATED
860 O.K. TRANSPORTATION COMPANY
861 ORAL ROBERTS UNIVERSITY
862 PAGE INDUSTRIES
863 PATTERSON SARGENT
864 PHARMASEAL LABS
865 PHILLIPS CHEMICAL
866 PHILLIPS PETROLEUM
867 POWELL SANITATION SERVICE
868 POWELL SERVICE COMPANY
869 PRESBYTERIAN HOSPITAL
870 PRESTOLITE CORPORATION
871 PRYOR FOUNDRY, INCORPORATED
872 PUBLIC SERVICE COMPANY
873 RA NAJ CIRCUITS, INCORPORATED
874 RANDY A_LID
875 REAGENT CHEMICAL & RESEARCH, INC.
876 RED BALL MOTOR FREIGHT
877 ROCKWELL INTERNATIONAL
878 ROCKWELL INTERNATIONAL CORPORATION
879 RODCC INCORPORATED
880 ROTEX CORPORATION
881 ST. ANTHONY HOSPITAL
882 S.&S. PLATING COMPANY
883 SANTA FE RAILROAD

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884 SCA SERVICES
885 SEARS AUTO CENTER
886 SENTRY MANUFACTURING
887 SERVETEL, INCORPORATED
888 SERVICE PAINT MANUFACTURING COMPANY
889 SHAKLEE CORPORATION
890 SHERWIN-WILLIAM COMPANY
891 SKY WITCH
892 SOLVENT MANUFACTURING COMPANY, INC.
893 SOONER FORD
894 SOONER OIL PATCH SERVICES, INCORPORATED
895 SOUTHERN HILLS COUNTRY CLUB
896 SOUTH PRAIRIE CONSTRUCTION
897 SOUTHWEST ELECTRIC COMPANY
898 SOUTHWESTERN STEEL ROLLING DOOR COMPANY
899 SOUTHWEST UNITED INDUSTRIES
900 SPERRY VICKER COMPANY
901 STAN RAMSEY COMPANY, INCORPORATED
902 STANDARD CHEMICAL COMPANY
903 STAR MANUFACTURING COMPANY
904 STEELCRAFT, INCORPORATED
905 STORM PLASTICS, INCORPORATED
906 SUBLETT & ASSOCIATES
907 SUN GAS
908 TEXACO, INCORPORATED
909 TEXAS INSTRUMENTS
910 TEX PRODUCTS, INCORPORATED
911 THE BUCKET SHOP, INCORPORATED
912 SAMUEL ROBERTS NOBLE FOUNDATION, INC.
913 THOMAS & BETTS
914 THOMPSON HAYWARD CHEMICAL COMPANY
915 UNITED STATES AIR FORCE
916 TRIBONETICS COMPANY
917 TOM BROWN'S OPTICAL
918 TOX
919 TRIGG DRILLING
920 TUFTS & SON OF OKLAHOMA
921 UNARCO COMMERCIAL PRODUCT
922 UNIROYAL TIRE COMPANY
923 UNIT PARTS, BORG-WARNER COMPANY
924 UNITED FOAM
925 UNITED PLATING WORKS, INCORPORATED
926 UNIVERSAL OIL PRODUCTS
927 UNIVERSITY OF OKLAHOMA
928 UNIVERSITY OF OKLAHOMA
929 UNIV. OF OKLAHOMA HEALTH SCIENCE CENTER
930 UNIVERSITY OF OKLAHOMA
931 COLONEL MARY FELTS
932 U.S. CORPS OF ENGINEERS
933 U.S. DEPARTMENT OF ENERGY
934 U.S. POLLUTION CONTROL
935 U.S. POLLUTION CONTROL
936 VETERANS ADMINISTRATION
937 WAYNE CIRCUIT
938 WELCH OIL COMPANY
939 WESTERN ELECTRIC COMPANY
940 WESTERN EXTRACT MANUFACTURING COMPANY

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941 WESTINGHOUSE ELECTRIC CORPORATION
942 WEYERHAEUSER COMPANY
943 WILSON DOWNHOLE SERVICES
944 W. J. LAMBERTON
945 WOLVERINE PIPE
946 ZOECON INDUSTRIES
947 OKLAHOMA GRAPHICS
948 U.S. SMALL BUSINESS ADMINISTRATION
949 GENERAL MOTORS
950 SUPERIOR LINEN
951 O.K. MEMORIAL HOSPITAL
952 JIM'S SEPTIC SERVICES
953 A-A EMERGENCY PLUMBING
954 RIVERSIDE INDUSTRIES
955 WASTE MANAGEMENT
956 INTERNATIONAL SYSTEM & CONTROL
957 P.A. INDUSTRIES-POLAR MANUFACTURING
958 AMAX, INCORPORATED
959 WASTE MANAGEMENT, INCORPORATED
960 SANDTRAP SERVICE
961 FOSTER FEED & SEED COMPANY
962 JOC OIL EXPLORATION COMPANY, INC.
963 ALLIED PAINT CORPORATION
964 BORG-WARNER CORPORATION
965 CLIFTCO, INCORPORATED
966 HONEYWELL COMPANY
967 COOK PAINT AND VARNISH COMPANY
968 CHEMICAL LEAMAN TANK LINES, INCORPORATED
969 DIAMOND PAINT COMPANY
970 EXXON CHEMICAL COMPANY
971 W.R. GRACE & COMPANY
972 GULF STATES PAINT COMPANY
973 RALPH LOWE
974 MAGNA CORPORATION
975 NALCO CHEMICAL COMPANY
976 THE O'BRIEN CORPORATION
977 P.P.G. INDUSTRIES
978 RELIANCE UNIVERSAL, INCORPORATED
979 ROHM AND HAAS TEXAS, INCORPORATED
980 WITCO CHEMICAL COMPANY
981 TRIANGLE ENGINEERING COMPANY

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APPENDIX C

COMMUNITY RELATIONS RESPONSIVNESS SUMMARY

ON THE SOURCE CONTROL FEASIBILITY STUDY

# COMMUNITY RELATIONS RESPONSIVENESS SUMMARY

# ON THE SOURCE CONTROL FEASIBILITY STUDY

## HARDAGE/CRINER SUPERFUND SITE

## MCCLAIN COUNTY, OKLAHOMA

NOVEMBER 1986

# COMMUNITY RELATIONS RESPONSIVENESS SUMMARY ON THE SOURCE CONTROL FEASIBILITY STUDY

## HARDAGE/CRINER SITE
## MCCLAIN COUNTY, OKLAHOMA

This document summarizes public comments and Environmental Protection Agency (EPA) responses to questions and concerns raised during the public comment period. The responsiveness summary is divided into four sections:

I. Overview

II. Activities to illicit input and address concerns

III. Summary of public comments and EPA response, and

IV. Remaining concerns

I. OVERVIEW

At this time, the Environmental Protection Agency (EPA) is presenting its response to comments on the Source Control Feasibility Study (FS) prepared for the Hardage/Criner site. EPA has not yet selected its preferred remedy but has developed four remedial alternatives which it believes to be cost-effective plans, meeting all applicable or relevant and appropriate Federal requirements for protection of public health and welfare and the environment.

This site is being managed through the EPA enforcement program. As such, EPA will make a decision on the "baseline" remedy which it feels to be acceptable. EPA will then negotiate with private parties believed liable for the site in an effort to achieve voluntary cleanup of the site. In a parallel manner, EPA is pursuing direct enforcement action under Section 106 of the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA) and under Section 7003 of the Resource Conservation and Recovery Act of 1976 as amended (RCRA).

When a remedy is proposed, EPA will be seeking public comment. Only after this comment period will EPA make it's final remedy selection.

## II. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS

### Major Concerns and Issues

One of the major concerns at the Hardage (Criner) hazardous waste site is evidence from monitoring wells of migration of contaminants from the site and contamination of residential wells offsite. The North Criner Creek alluvium is the primary aquifer of concern.

Deteriorating conditions at the site (i.e., continuous seepage from the pits, exposed barrels from the mound, etc.) and inadequate barriers to retard migration, have given rise to concern for potential surface and groundwater contamination.

### Activities to Elicit Public Input and Address Concerns

EPA has kept members of Congress, as well as other elected officials and citizens informed of meetings, plans, and alternatives under consideration. Elected officials and citizens were notified prior to start of the Remedial Investigation and Feasibility Study (RI/FS) process.

Ten families live in the immediate vicinity of the site. Each family was interviewed by representatives of the Oklahoma State Department of Health (OSDH) and the EPA to ascertain their concerns and feelings about the site. Primarily, these citizens' concerns centered around contamination of the groundwater, which was originally discovered in the mid 1970s by the State of Oklahoma in onsite monitoring wells. Since that time, EPA and OSDH have expended considerable joint effort and resources to determine the nature and extent of the contamination. Royal N. Hardage, owner and operator of the site, was sued by the United States in September 1980, seeking investigation and clean up of the site. Although the United States established it's case and won a partial judgement against Royal Hardage, it was unsuccessful in obtaining site clean up, in large part due to Mr. Hardage's bankruptcy. The U.S. Government filed suit in June 1986 against 36 companies believed to be responsible for public health threats posed by the site, seeking performance of remedial actions and further studies as directed by EPA as well as reimbursement of all Superfund costs incurred, which is more than $1.4 million.

A press release announcing the end of the Feasibility Study, start of the public comment period, and a public meeting, was issued by EPA on February 24, 1986. Copies of all formal documents concerning the site were placed in five strategic repositories for the public to review preparatory to making their comments. Preceding the public meeting held on March 20, 1986, EPA briefed the mayors and other city officials of both Chickasha, Oklahoma and Purcell, Oklahoma. At this briefing, EPA reviewed past actions and ongoing and future planned site activities.

## SUMMARY OF PUBLIC COMMENTS RECEIVED DURING THE COMMENT PERIOD AND EPA RESPONSE

The public comment period on this FS was from March 10 through April 15, 1986. The FS was placed in repositories and provided to the Hardage Steering Committee (HSC) on February 25, the day after a press release announced the end of FS activities. A March 20, 1986, public meeting was attended by approximately seventy people, nine of whom made statements. Fourteen sets of written comments were received, consisting of over 200 pages. These comments were received from:

1) B&F Engineering - for Weyerhauser
2) Gardere & Wynne - for L&S Bearings, Rotex, and Tribonetics
3) Hardage Steering Committee - a PRP group representing 135 parties, submitted their own comments as well as those of three consulting firms retained by the HSC: Dames & Moore, ERM-Southwest, and MDK Consultants
4) Hildebrandt Tank Service
5) Hill & Robbins - representing U.S. Pollution Control, Inc.
6) The Hardy Horton Family
7) Hunton & Williams - representing Oklahoma Gas & Electric, comments endorsed by AT&T
8) Kerr McGee
9) League of Women Voters
10) Rajeanna Mayo
11) Oklahoma Center for Veterans Rights
12) Pat Shepherd
13) Thompson & Knight - representing Firestone
14) Glenn Webb

Comments were also received during the public meeting from the following parties: Glenn Webb, Kinnan Goleman (for HSC), Neal Garrett, Tom Smith, Roberta Olefield, Linda Wall, Faith Hurley, Ben Kalas (for KWCL news) and Mark Fox.

After analysis of the comments, it was decided to organize the responsiveness summary into seven sections, each dealing with comments on a specific subject. These seven categories are:

A) Adequacy of data,
B) Operable unit approach,
C) Compliance with the NCP,
D) Feasibility Study process,
E) Opportunity for public participation,
F) Recommendation for additional study or interim remedial measures; and
G) Other comments

A) ADEQUACY OF EXISTING DATA ON THE HARDAGE/CRINER SITE

Several commenters suggested that existing data is inadequate to fully characterize the site and develope a permanent and cost effective remedy. Based on the volume of comments, it appears that either the consultants which these individuals employed are not fully aware of the amount of existing data or that a substantial difference of opinion exists between EPA and the Hardage Steering Committee (HSC) as to what would constitute "adequate data". EPAs "Guidance on Remedial Investigation under CERCLA" indicates in Section 7.2.3 that the extent of investigation should not be more than is "necessary and sufficient" to satisfy site-specific objectives. Such objectives were defined early by EPA and are documented in the November 1983 work plan prepared by $CH_2M$ Hill. In the case of a source control action data must be, and in this case is, adequate to establish the degree of containment of the waste materials with reasonable certainty. The data must also allow developement of feasible alternatives for remediation of the site, screening of these alternatives, and ultimately selection of an appropriate cost-effective alternative for remedial action. As in any engineering or scientific study, 100% of the available data could never be gathered. As more and more is learned about the site, further data gathering efforts will become less productive and of less value in providing new information and more duplicative of previous studies. At this point, the Agency believes that sufficient knowledge of the source areas of waste and their current state of containment does exist to allow decisions based on fact and sound engineering principles (not on assumptions or conjecture) to be made as to the appropriateness, feasibility, and cost effectiveness of a range of source control remedial alternatives as required by the National Oil and Hazardous Substances Contingency Plan (NCP), 50 Fed. Reg. 47950, November 20, 1985.

The level of data gathering suggested by some commenters indicates confusion about the purpose of an FS and the preceding investigative efforts. The data gathered prior to remedy selection on a Superfund site is not intended to be so complete as to allow preparation of detailed design for each remedial alternative or even for the remedy selected. For example, it would make no sense to collect the extensive data required to design four remedies when only one will be selected. The data only needs to be sufficient to determine the most cost-effective feasible remedy protective of public health and welfare and the environment, not inconsistent with the NCP.

Several commenters pointed out what they believed to be data gaps in EPA's characterization of groundwater hydraulics and other contamination outside the source areas. Since a separate RI/FS is planned to specifically address this, the second operable unit, the comments are noted for future reference in development of the workplan for the second operable unit (Management of Migration) RI/FS.

Response to specific questions and comments regarding the adequacy of data is provided below:

Comment: Certain data indicate that the bedrock may be fairly impermeable and caple of preventing waste migration, specifically: the yield of water from interceptor wells installed by the operator are low, as reported in the FS; the packer permeability tests conducted by EPA contractors in 1984 indicate the permeability of bedrock is very low, less than $10^{-7}$ cm/sec.

Response: It should be noted that the packer tests indicated permeabilities were less than $8 \times 10^{-7}$ cm/sec. Packer tests, when conducted properly and under favorable conditions, can provide an indication of the permeability around the well bore. This does not necessarily reflect overall permeability of the bedrock or the ability of seepage to move rapidly through joints. The intact bedrock, especially shales, at this site may have hydraulic conductivities on the order of $10^{-7}$ cm/sec. or less. However, EPA believes secondary permeability (fractures/joints) rather than porosity, characteristics have allowed existing contaminant transport. As stated in the FS, the results of site packer permeability tests would not have been significantly affected by thin, occasional layers with hydraulic conductivities on the order of $10^{-1}$ to $10^{-3}$ cm/sec or an occasional thin fracture. This statement is based on estimations of the water loss through a thin pervious layer within the packer test sections. Based on the tests conducted at the site, such a layer would not result in sufficient water loss during the test to result in an overall hydraulic conductivity of greater than $10^{-7}$ cm/sec, but would allow contaminant migration at relatively high velocities in these secondary channels.

As discussed in the FS, difficulties are inherent in monitoring groundwater quality in a fractured aquifer. The absence of contamination in a single well, for example, cannot be taken with any confidence to mean that contaminants have not reached that general area. This is apparent when one considers the relatively minor area intersected by a well bore as compared to the areal and vertical extent of the aquifer which this well would be intended to monitor (a six inch well bore with a twenty foot long screened-sampling-section might be placed hundreds to thousands of feet from other wells and represent the only data on this section of the aquifer). When groundwater flow occurs through preferential channels, as at Hardage, the interception of contaminated flow pathways is largely reduced to a matter of chance. The consistent presence of contamination in the majority of wells spaced over a wide area carries great weight in proving the aquifer to be contaminated; and such a situation is correctly taken to represent contamination of the entire area monitored by the contaminated wells.

The yield of the Hardage Wells was reported incorrectly in the FS as one barrel per day. The yield, as stated by Royal Hardage in a 1980 deposition was in fact 25 barrels per day for each of two wells.

Comment: The groundwater contour map presented in the FS was developed with data from different zones. This is not a correct procedure since deeper bedrock may be hydraulically confined or vertical gradients may exist, making contours developed in this manner deceiving.

Response: The Bison and Purcell Formations are undifferentiated at the site, comprising a single unconfined hydrogeologic unit; and present data indicates the bedrock is hydraulically connected in the vertical direction and in communication with the alluvium. Therefore, the use of all water level measurements at the site in preparing the ground-water contour map presented in the FS is only subject to errors caused by vertical gradients. Vertical gradients in ground-water do exist and do influence the phreatic surface obtained from monitoring wells installed to various depths. During the investigation for the second operable unit, nested wells will likely be installed to further evaluate vertical gradients at the site. Based on this information, a refined contour map may be developed. Overall, this only has an impact on the second (management of migration) operable unit.

Comment: Data from waste characterization holes drilled through the sludge mound and main pit suggest that vertical barriers to seepage exist beneath these areas.

Response: Some data, when analyzed in a cursory manner, could indicate barriers to seepage exist below source areas. However, the observed vertical migration of contaminants and their lateral spread into areas where no other pathway could exist but through groundwater transport overwhelmingly indicates that vertical barriers do not prevent susbstantial releases of contaminants from the shallow to the deeper groundwater.

Comment: The vertical extent of contaminant migration has not been defined, neither have the vertical flow gradients that would induce such migration. Such information is needed to fully characterize site hydrogeology and adequately develope and evaluate remedies.

Response: Vertical migration of contaminants through the bedrock to depths greater than 40 feet has been documented to the east, southwest, and directly beneath the source areas. The information obtained from the waste characterization (WT) holes does indicate vertical contaminant migration beneath the source areas, as discussed in the response to latter comments. In addition, ground-water contamination found in wells EW-01, BW-01, BW-04 and GTW-03 indicates contaminants in ground water at depth. In each of these wells, the well screen interval was placed beneath the phreatic surface measured at the well location, thus contamination found at these well locations are beneath the surface of the ground-water table and confirm vertical migration. In addition, several wells and exploratory boring locations were installed adjacent to deeper wells. Although these were not specifically intended to constitute nested wells, information obtained from these locations indicates a gradient from shallow to deep groundwater.

Comment: Piezometric levels of groundwater were measured in January and aren't representative of the entire year due to seasonal fluctuations. This limited data cannot indicate to what degree wastes in the source areas are beneath the water table.

Response: EPA agrees that the levels may represent a low as compared to the rest of the year. However, relative levels and the shape of groundwater contours and flow directions likely represent an annual average and are consistent with those developed by earlier investigators (Baker & Burns, 1980; Kent, 1982). Seasonal fluctuations could be better defined in further studies.

Comment: Geologic cross-sections were not compiled. Such sections could aid in analyzing site geohydrology, and are a tool commonly used to perform such analyses.

Response: The bedrock consists of shales, mudstones, and sandstones which are deposited in discontinous layers. These layers grade gradually back and forth from one rock type to another. Since this gradation occurs in three dimensions, the classical concept of a well defined sequence of horizontal or consistently dipping beds which allows tracing individual layers of the sequence from one borehole to the next is not applicable. As a result of this graded lithology, EPA could make only limited interpretations and would have had virtually no confidence in cross-sections compiled with data from these or any other bedrock borings. For this reason, cross-sections were not refined or published.

Comment: The site may not be suitable for locating a landfill cell in compliance with RCRA Part 264 regulations; and data is inadequate to make this determination. This should have been considered before retaining the On-site Disposal Alternative through final screening.

Response: EPA believes the existing data indicates that the site is suitable for placement of a RCRA vault; and further study will be conducted for design should this alternative be selected. Due to the widespread contamination on-site, low levels of residual contamination will remain in the soils over which the landfill would be constructed. A questions was raised by one commenter as to the potential problems of monitoring for leaks from the landfill cells, that is, if contamination were seen in monitoring wells questions could arise as to whether it is coming from trace landfill's liner systems. It is EPA belief that monitoring in a possibly contaminated environment will not present insurmountable technical problems since: (1) The vault will have an interior detection system capable of detecting any leaks before they enter a contaminated zone; (2) the vault will be above the groundwater table, eliminating potential up-flow of contaminants into the interior detection system; (3) regular monitoring will likely be required for any remedy, and long term water quality trends could be established, allowing significant leaks from the exterior liner to be detected. The site is located over several thousand feet of sediments and is not prone to earthquakes. The area of the site considered for locating a landfill cell is far above the 100 year flood and also above the probable maximum flood. Thus, the site meets the requirements set forth in 40 CFR Section 264.18.

Comment: The geometry of waste fill is not defined. Without such data, it is not possible to adequately evaluate any alternatives or determine either the Feaibility in in-situ containment or the need for excavation of the source areas.

Response: The base of pits excavated during site operations and later backfilled is defined by depositions of the operator Royal Hardage and confirmed by test holes in these source areas. The borings show bedrock at consistent elevations of about 1109 and 1093 feet mean sea level (MSL) beneath the main pit and sludge mound respectively, thus defining the base of the pits. Magnetometer surveys have located substantial drum concentrations in the drum mound and along the west side of the main pit, also confirming early site inspections and the Hardage depositions.

Comment: A Quality Assurance plan was not prepared in accordance with the NCP. As such, the accuracy of the data and the methods of data collection are questionable.

Response: The Quality Assurance Project Plan (QAPP) is included as Appendix A to the May 1985 Data Summary Report. This QAPP meets all the requirements of the NCP (1982 edition), including concurrence on the plan by the Regional QA officer.

Comment: Sampling from three test holes in the sludge mound failed EPA's requirements for QA/QC. This lack of data prevents EPA from making decisions on the disposition of the materials since it can make no judgement on it's potential threats.

Response: After completion of the Feasibility Study, EPA's Houston Lab was asked to review the data. The principal problem was that lab reporting sheets indicated the units to be parts per million (ppm). Summing the various constituents indicated certain samples with a sum greater than a million ppm, indicating an obvious error. The Houston Lab's review showed that the units were incorrectly reported and in reality should have been parts per billion (ppb) rather than ppm. This has corrected virtually all problems with this data set. The Houston Lab review is documented in an August 1986 letter from Bill Langley (EPA-Houston) to Bob Davis ($CH_2M$ Hill-Dallas).

Data also exists from previous sampling of the sludge mound and in some cases for wastes disposed there. In addition, the types of wastes disposed in the sludge mound are known for the most part to be: styrene tars; drummed aresenic and cyanide; PCB contaminated equipment; and sludges from oil recycling, the analysis of which showed extremely high levels of lead and phenol as well as over 50 ppm of PCBs; and a composite of all other wastes disposed at the site as a result of clean-out of the main pit. Samples taken in 1982 from the surface of the sludge mound indicated PCB-1260, lead, chromium, anthracene/phenanthrene, dichloropheonol, and other heavy metals and synthetic organics.

Comment: Poor well drilling techniques may have resulted in cross-contamination of some monitoring wells and waste characterization holes; thus the results may not indicate deep contamination of soil and/on groundwater.

Responses: Discussion is made regarding the contamination found in the waste characterization holes (WT) beneath the source areas. It is suggested by the commenter that only trace levels of contaminants were detected in bedrock samples beneath the pits and that they are "probably associated with inadequate sampler decontamination... or laboratory contaminants". As presented in the Data Summary Report, EPA (1985), rinsate samples taken from the sampler after decontamination did indicate a few contaminants at parts per billion levels in addition to laboratory contaminants. The contention by some commenters is that bedrock contamination beneath source areas was mainly the result of sampler and laboratory contamination; however, this is not substantiated by overall sample analyses. Consistently, compounds other than those found in the rinsate and laboratory blank samples were found in bedrock samples beneath the sources. In many instances, these compounds had concentrations in the parts per million range (orders of magnitude higher than that shown in blanks). In addition, in several holes, compounds were found in the underlying bedrock samples which were not found in samples taken within the source area nor in rinsate or laboratory blank samples. These compounds are however components of wastes known to have been disposed at the site. The obvious conclusion here is that the wastes were not, as the commenter suggested, carried down the borehole by careless sampling procedures, nor were the compounds introducted at the lab or at any time after the samples were collected; rather the contaminants are in fact, as EPA has previously stated, at depth beneath the source areas and represent the result of actual waste migration vertically out of the waste pits and into underlying sediments. In waste characterization hole (WT-006), the results of the analysis of the composite sample comprised of samples from 28,33 and 38 feet showed very few volatile compounds; however, the sample taken at 43 feet showed many more volatile compounds present. EPA believes this pattern of contamination is more indicative of vertical migration through the bedrock along secondary permeability features than the result of trace contamination on sampling tools. Well GTW-03 showed contamination in groundwater as did the nearby BW-04 well; however, analysis of borings taken from GTW-03 showed no contamination of the overburden, thus precluding contamination of this well during construction.

(For further discussion, refer to a previous comment on vertical migration of waste page C-8).

Comment: No data exists to support EPA's contention that a hazard exists from air on the site.

Response: EPA recently sent its Emergency Response Branch (ERB) to the site for purposes other than air monitoring; however, this was also done while on-site, sampling with a photoionization unit showed readings less than 1 ppm in air. It has been observed that odors are much worse on-site in wet weather than dry wheather-when ERB visited the site. At this time, EPA must reply that it has no data which indicates an air hazard from organic vapors exists on-site at this time. It is entirely possible however, that deteriorating site conditions could pose threats by this exposure pathway.

Comment: Use of area groundwater is not adequately assessed to determine the need for remedial actions.

Response: Those groundwater supplies with the potential to be immediately affected have been considered. Other supplies which could ultimately be impacted as wastes migrate farther from the site will be assessed in detail during groundwater/off-site studies.

Comment: The groundwater pathway of contamination transport off-site has not been sufficiently defined. The potential for groundwater contamination has been cited as one factor requiring remedial action, yet it's potential impact have not been adequately assessed.

Response: Pathways of groundwater contamination transport were only considered insofar as they indicate a general inability of the bedrock to provide a reasonable degree of containment of wastes in the source areas. The presence of contamination in the alluvial aquifer of North Criner Creek and the route of transportation from the source areas are by and large irrelevant to the question of the adequacy of barriers beneath these source areas several thousand feet away. EPA still believes that contamination of this aquifer has resulted from combined runoff and sub-surface transport. The question of which pathway has contributed what to current contamination is of only academic importance, since significant subsurface migration has occurred in this and other directions, and contamination of the alluvium by this method will continue or began to occur until the sources are exhausted.

Comment: Source areas may exist which have not yet been identified. If this is the case, then the source control FS is incomplete.

Response: Sufficient information on the operating history of the site is available from Oklahoma State Department of Health (OSDH) inspections from 1972-1980 and from the operators depositions to confirm that Mr. Hardage made efforts to consolidate wastes in the main pit/drum mound and sludge mound. Site samplings and recent inspections give no reason to doubt the belief that the major concentrations of solids, sludges, and drummed wastes are located in the three principal source areas addressed by EPA in its FS.

Even if other major source areas did exist, it would not preclude EPA from addressing the drummond, main pit, and sludge mound as a single operable unit. The NCP provides no such constrainst on what must be included in an operable unit or on how many operable units a site may be divided into.

Comment: Background quality of groundwater has not been determined. Without knowledge of background concentrations of chemicals or elements, it is impossible to determine if the site is contributing the compounds or if the levels are naturally elevated and unrelated to the site.

Response: The background levels of synthetic organics (such as solvents) in this rural area is essentially zero with the possible exception of pesticides from agricultural application, and trace levels of natural phenol in groundwater. The background levels of inorganics will be fully addressed in the Management of Migration RI.

Comment: The extent of groundwater contamination has not been adequately defined; and no plume has been shown to emanate from the source areas. As a result, it is premature to determine that groundwater contamination requires any remedial action.

Response: Great difficulties exist in monitoring a fractured aquifer where migration is along preferential channels, and where a heavily contaminated zone might lie within a few feet of an apparently clean monitoring well. This characteristic makes the classical concept of a contaminant "plume" misleading and inappropriate for describing migration patterns at this site. In future studies, EPA will undertake to delineate the plume present in alluvium of North Criner Creek, further define the lateral extent of groundwater contamination in the bedrock, and evaluate the potential for contaminants to migrate beneath stream drainage divides near the site. Such investigative activities properly fall within the scope of the second operable unit.

Comment: Trends show water quality is improving with time. This could indicate that the situation is not worsening, but rather that the groundwater system is recovering by natural processes.

Response: The historical water quality data is indicative of the presence of off-site contamination. It is not felt that trends in contaminant concentrations can be drawn from the information, since the samples were taken by various parties using widely varying sampling procedures. Specifically, some samples were obtained from taps at the residences rather than directly from the well, thus subjecting the water to aeration during pumping and stripping of some volatiles.

If off-site sampling results from various sources were comparable, the well with the largest historical data base (the old Corley well), does not show any trend whatsoever. Contamination is similar to the levels first seen in late 1982, two years after the site closed.

B) EPA's OPERABLE UNIT APPROACH TO THE HARDAGE/CRINER SITE

Comments were received which questioned the technical and legal justification for EPA's decision to divide the site remediation of groundwater/off-site contamination as discrete and separable problems.

EPA has addressed a substantial number of NPL sites, including several in Region 6 (Bayou Bonfuca, Gurley Pit, Vertac, Motco, Highlands Acid Pits, Odessa Chromium I, and Odessa Chromium II), by dividing the response into operable units. These divisions are made based on technical information for the site and the criteria presented in the NCP. As noted in the FS, EPA believed at the time the division was made, and continues to believe, that a substantial quantity of wastes remain in or near their original location and are not contained by adequate barriers and that a remedy for source control will be cost-effective and consistent with a premanent overall remedy for the site, thus meeting criteria set forth in the NCP for operable unit remedial response. The best engineering judgement of the Remedial Site Project Officer (RSPO), EPA Regional and Headquarters managers, and EPA contractors was that the vast majority of releases of hazardous substances to the environment could be abated by controlling these source areas which comprise less than 10% of the site area. Strategies for cleanup of existing groundwater contamination or knowledge of the necessity of such actions is not necessary in order to determine the best method of containing the wastes. Source control and management of migration are in this case clearly seperable; therefore, further delays are unnecessary and would be inconsistent with provision of a timely response to a situation posing an imminent and substantial endangerment to public health and welfare and the environment.

Response is provided below to specific comments on the operable unit approach taken on the Hardage site.

Comment: No technical justification exists for an operable unit approach to the Hardage site; the decision to address the site in this manner was driven by budgetary problems and previous delays in completion of the FS.

Response: The technical justification for splitting the site into operable units is strong, as discussed above. The questions about pathways of contaminant transport to offsite alluvium and the extent of surface contamination away from the source areas are not mandatory considerations in the question of source control and the existence of barriers to migration. Since all proposed source control alternatives involve waste excavation and stabilization, which remedy is finally selected is not a concern in relation to the Management of Migration operable unit, therefore delays to determine the groundwater/offsite remedy are unnecessary. The criteria set forth in the NCP for use of operable units has been met; and no strong justification exists for not using the approach and further postponing cleanup of the site. The comment that EPA employed operable units due to budgetary problems is unfounded; the cost of the DSR/FS project was slightly over $800,000 less than is sometimes spent or far less complicated sites.

Comment: EPA has worked on the site for three to five years; so expediting the remedy makes no sense at this point. Further studies should be conducted and a new FS prepared to address the site as a whole rather than as operable units.

Response: EPA first inspected the Hardage site in July 1979; and a complaint was filed against the operator in September 1980 under Section 7003 of RCRA. While EPA has been involved with the Hardage site for nearly seven years now, active Superfund involvement did no begin until 1984. Field work was commenced by EPA in July 1984 and the FS was released in February 1986, twenty months later; the normal period of time in which EPA attempts to complete its investigations and FS on Superfund sites is eighteen months. Delays on this site under Superfund have have not been exceptional; and any delays which have occurred do not provide a justification for further unnecessary delays.

Comment: A cost effective remedy can't be selected without knowing the final remedy for other parts of the site.

Response: The situation at Hardage is such that excavation and treatment of the waste piles and pits is required (FS, pages 3-22 through 3-36). Therefore, the cost-effectiveness consideration is reduced to a comparison of various treatment technologies and their relative feasibility, benefits, and permanence. Cost-effectiveness considerations are only to be applied in comparisons between acceptable remedies in accordance with Section 300.68 of the NCP.

Comment: A remedy for source control should not have to meet applicable or relevant and appropriate requirements since it is not the final remedy [(NCP, Section 300.68 (i)(5)(i)].

Response: The remedies which EPA has developed and evaluated, while not addressing the entire site, are permanent for the source control operable unit. As such, response actions must be in accordance with these requirements just as if this remedy were for all aspects of the site. The passage cited in the NCP refers to interim remedial measures (such as a temporary cap) which may be implemented while further study or planning is conducted for the permanent remedy.

Comment: The lack of data needed to complete a FS for the entire site prompted EPA to divide the site into operable units; and these same data gaps also plague the source control FS. This prevents EPA from determining the nature and extent of the threat posed or evaluating proposed remedies.

Response: The "data gaps" are of a quite different nature than the commentor has implied. Data indicates that releases from the site are uncontrolled; and knowledge to site conditions indicates the situation will worsen.

Data is inadequate to determine the appropriate remedy for contaminants that have already left the site or the extent of cleanup required for surface mixing areas which may remain contaminated. However, it is EPAs opinion that the existing data is adequate to allow development of a source control Feasibility Study. The blanket statement that these inadequacies plague the FS was not supported with examples by the commentor. And in the conduct of the FS, EPA has certainly not felt itself to be "plagued" by this or any other lack of information.

## C) EPA COMPLIANCE WITH THE NATIONAL OIL AND HAZARDOUS SUBSTANCES POLLUTION CONTINGENCY PLAN (NCP), 40 CFR PART 300*

Several commenters questioned EPAs compliance with the NCP during conduct of response action at Hardage. The comments ranged over many points of the NCP, but were centered on Subpart F - Hazardous Substances Response.

General comments were that EPA had not adequately characterized the site; the screening of remedial alternatives was flawed or biased; an operable unit approach is not valid for Hardage; applicable or relevant and appropriate requirements for protection of public health or welfare or the environemnt were incorrectly applied or should not have been applied at all; EPA should have further considered waivers provided in the NCP and further evaluated those alternatives providing less than adequate protection of public health and welfare and the environment; and cost-effectiveness was not given adequate consideration.

One important purpose served by the NCP is to provide consistency in application of CERCLA from one site to another and from one Regional program to another; and deviations from the NCP could possibly reduce this consistency. The current NCP was followed at all points through the FS process; and compliance with the NCP was a major factor in review of drafts of the FS. Where formal guidance documents and memos covering compliance with the NCP existed, the material was used. As a result, EPA believes that the FS is entirely consistent with the NCP.

Response to specific comments is given below.

<u>Comment</u>: EPAs failure to perform a formal RI is inconsistent with the NCP since: 1) the NCP does not suggest EPA may decide not to conduct an RI when one is clearly appropriate; and 2) the data collected does not serve the purpose of a RI.

<u>Response</u>: The NCP directs that EPA shall "as appropriate" perform an RI/FS. This passage does not bind EOA to do an RI if it is not appropriate. EPA determined that a discrete RI was not appropriate in light of the already extensive data compiled on the site. The purpose of an RI/FS, as explained in the nature and extent of the threat presented by the release and to evaluate proposed remedies (50 <u>Fed Reg</u>). This purpose has been met.

*The NCP was promulgated, and is periodically revised, as required by CERCLA, Section 105. The NCP sets forth the approach to be used in implementing CERCLA. The most recent revision of the NCP was February 18, 1986 (50 <u>Fed. Reg</u>. 47912-47968.

- On the other hand, EPA believes that the aggregate of prior studies and data on the site, when combined with its "Field Investigation and Data Summary Report", would in fact constitute a record of substantial equivalence to a discrete RI. Therefore, the decision was made to move directly to the FS.

- EPA must make decisions on how to proceed in cases such as this based on the best judgement of the RSPO and EPA managers, and it has acted in a manner not inconsistent with the NCP in deciding against the additional investment in time and effort an RI would have involved. The commenter does not elaborate on why a descrete RI was "clearly appropriate" on this site.

<u>Comment</u>: The FS is not the functional equivalent of an Environmental Impact Statement (EIS) as required by the National Environmental Policy Act of 1969 since the FS does not contain a cost/benefit analysis.

<u>Response</u>: Conduct of a cost-benefit analysis is not required under CERCLA; this is confirmed by the Act's legislative history (136 Cong. Rec. §16427 (1980).) Furthermore, the public comment period on the FS serves the opportunity for comments required under NEPA prior to expenditure of public funds.

Comment: The five waivers applying to remedy selection as set forth in the NCP Section 300.68 (i)(5) should be applied and a remedy selected which does not meet or exceed applicable or relevant and appropriate requirements for protection of public health or welfare or the environment, due to the high cost of remedial actions meeting these requirements or due to other circumstances set out in the NCP.

Response: The five waivers are stated below along with the reasons they cannot be applied to the Hardage site.

1) <u>Remedy will become part of a more comprehensive remedy</u> - This is the final remedy for source control.

2) <u>Fund-Balancing</u> - This test is normally applied where there is a fund-financed response. This is an enforcement lead site; but there is nothing to indicate fund balancing would be involved even if this were a fund-financed response.

3) <u>Technical Inpracticality</u> - Remedies meeting requirements are technically feasible and can be implemented.

4) <u>Unacceptable Environmental Impacts</u> - This is not anticipated since the impacts of continued release out weigh those associated with remedial action.

5) Enforcement action where the fund is not available, public desire for cleanup is strong, and litigation would probably not result in a better remedy - EPA believes that, if necessary, litigation will produce the desired result and fund may be available. It should be noted that Hardage/Criner is a National Priority List (NPL) site, so the Superfund may be applied to remedy the site if the Agency chooses.

For the above reasons, the waivers will not be applied; and the selected emedy will comply with all applicable or relevant and appropriate requirements.

Comment: Consideration of incineration as a disposal option violates the cost-effectiveness requirement of the NCP.

Response: Incineration was retained for consideration since the environmental benefits of organics destruction compared to waste treatment and landfilling are significant. EPA believes consideration of waste destruction alternatives, such as incineration, is warrantec and that the failure to consider waste destruction would be contrary to the Agencies commitment to consider permanent remedies including those which exceed applicable or relevant and appropriate requirement

Comment: Scoping of response actions was not conducted in accordance with Section 300.68(e) of the NCP.

Response: EPA believes that it in fact has properly considered all of the scoping factors required by Section 300.68 of the current and former NCP, as appropriate. Other comments on compliance of the FS with the NCP are addressed in the following section.

D) The FEASIBILITY STUDY (FS) PROCESS

Comments were received to the effect that the technology screening, alternative development and screening, and other components of the Feasibility Study process were flawed due to a lack of data or non-compliance with the NCP.

While it is true that a lack of adequate data could bias the results of the FS by forcing the preparers into unwarranted assumptions, the discussion provided in Section A of this summary regarding what constitutes "adequate data" is referenced. And, as in response to comments in that previous section, it is again stated that EPA believes the data is adequate for the purpose of a FS on Source Control. The data may not be adequate for detailed design; but that is not the present objective. The purpose of this FS is merely to present analysis and discussion sufficient for selection of a permanent remedy for source control.

Comment:

"(EPA) has rejected alternatives found to be protective of public health and welfare and cost-effective at numerous other Superfund sites". This commenter expressed the opinion that EPA had inappropriately rejected in-place containment alternatives. The commenter went on to cite 15 Superfund sites in other Regions which they felt were in conflict with the remedies considered at Hardage. These sites are:

| | |
|---|---|
| Region #1 | Beacon Heights Lanfill, Connecticut;<br>McKin County (Landfill), Maine; |
| Region #2 | Love Canal, New York;<br>GEMS Landfill, New Jersey;<br>Sinclair Refinery, New York;<br>Helen Kramer Landfill, New Jersey |
| Region #3 | Heleva Landfill, Pennsylvania;<br>Lackawana Refuse, Pennsylvania;<br>Taylor Borough Dump, Pennsylvania<br>Douglasville Disposal, Pennsylvania |
| Region #4 | White House Waste Oil Pits, Florida |
| Region #5 | Wanconda Sand & Gravel, Illinois<br>New Lyme Landfill, Ohio |
| Region #10 | Ponders Corner, Washington<br>South Tacoma Channel, Washington |

(No sites were referenced in Region #6, where Hardage/Criner is located.)

Response:

At this time, there are hundreds of sites on the Superfund National Priority List. These sites present unique combinations of factors involving geology and hydrology, as well as the age, quantity, and chemistry of contaminants, among other things. For this and other reason, neither Congress nor EPA has ever taken the position that consistency between or among Superfund sites is the measure of the appropriateness of Superfund remedial action at any given site. The specific test upon which basis Superfund remedial actions are judged is their consistency with the NCP. In numerous policy promulgations, EPA has attempted to further clarify those principles which guide Superfund response efforts. The policy and guidance documents have changed during the past six years of Superfund implementation; and they will continue to evolve and expand their scope in the future, reflecting a predicted increase in the body of knowledge concerning contaminant chemistry, health and environmental effects, contaminant fate and transport, and waste control, treatment, and destruction technology, among other things. As addressed elsewhere within this responsiveness summary, as well as within the FS itself, EPA believes that its remedial action proposals are not inconsistent with the NCP as discussed in the previous section of this Responsiveness Summary.

For informational purposes, a brief summary of characteristics, differences, and similarities of the 15 indicated sites vis-a-vis the Hardage site is presented below, along with a summary comparison of their respective remedies. As the information presented suggests, the commentator's point is at best overly simplistic and factually inaccurate. Review of these sites readily shows why capping may be an acceptable component of the remedies (just as capping may be included in the second operable unit at Hardage). The 15 sites referenced can generally be broken into four categories as discussed below:

Contaminated Municipal Landfills:

Beacons Heights, Heleva, Lackawana, Taylor Borough, New Lyme, and Wauconda fall into this category. Such sites are characterized by relatively minor amounts of hazardous materials co-mingled with large volumes of municipal trash. In this type of situation, wastes are of a far different nature than the highly concentrated wastes at Hardage.

Capping of wastes in-places was used only on two sites, Beacon and New Lyme. At New Lyme, little or no groundwater contamination has occured or is likely due to hydrogeology. At Beacon Heights, contaminants are dispersed and removal is not feasible. Two other sites, Lackawana and Taylor, utilized capping only after partial waste removal. In both cases, well defined concentrations of drums were present and were removed; the wastes capped were almost exclusively municipal in nature. One site, Wauconda, used a cap as an interim measure. The purpose of the cap was to control surface seepage to a stream.

Waste Oil Recycling/Refining Operations:

The McKin, Sinclair, Douglasville, White House, and South Tacoma sites fall into this category. At such sites, the principal concerns are open pits of liquid waste and waste spills. Spills represent dispersed waste for which removal would rarely be a feasible option. Pits are drained on most such sites, resulting in almost total source removal. At all five sites noted above, emergency or remedial actions included partial or complete source removal followed by capping of contaminated soils in former source areas. This is analogous to the proposed removal of source areas and possible capping of the former pits at Hardage.

Hazardous Waste Landfills:

The Love Canal, GEMS, and Helen Kramer sites are in this category. Hardage is similar to these sites only in the respect that similar waste types were disposed. At Helen Kramer and Love Canal, barriers to vertical migration exist. The layers make slurry wall cut-off feasible; sands overlying the aquitards lend themselves to easy construction of the wall and simple and effective groundwater management. At the GEMS site, no shallow layer is present; however, a thick sand layer allows effective groundwater management. In addition, drummed liquids are not present as they are at Hardage.

Presented below is a brief summary of site characteristics, differences and similarities between the site and Hardage.

<u>Beacon Heights Landfill</u>    Region #1    #203 on NPL

Beacon Falls, Connecticut

- municipal/industrial waste landfill operated 1920-78
- little drummed or other waste remains; most waste was burned as it was received and only its residues remain
- groundwater is contaminated in fractured bedrock

Remedy-Upgrade cap; groundwater decisions deferred

Comparison to Hardage:

Similarities - fractured bedrock underlies both sites

Differences - The majority of waste once disposed at Beacon Heights is municipal. Little waste remains in its original location, most has been burned or already released to the groundwater system.

Remedial Elements:

The sites are not comparable since a well-defined source is present at Hardage; and the sources at Beacon Heights are dispersed, making source control inappropriate.

McKin County (landfill) Region #1 #33 on NPL

Gray, Maine

- waste oil recycling site operated in the late 1970s
- soils are heavily contaminated by spills of solvents
- all surface tanks and drums have been removed;

Remedy:

Soil contaminated above the clean-up level (11,000 cubic yards) will be excavated; soil will be aerated and the off-gas burned; capping will be over areas below the clean-up level

Comparison to Hardage:

Similarities - solvents contaminate both sites

Differences - McKin was a recycling as opposed to disposal facility; no drummed wastes remain on-site

Consistency with removal at Hardage:

In both cases wastes will be excavated and properly disposed. McKin is farther along in remedial process (cleanup levels selected already) but the remedies appear entirely consistent.

GEMS Landfill Region #2 #12 on NPL

Gloucester Township, New Jersey

- industrial waste landfill operated from 1970 to 1974
- solid and liquid waste was mixed in pits; few or no drums were disposed
- 6 million cubic yards of contaminated fill present
- 150 feet of permeable sands underlie site, making groundwater recovery feasibile

Remedy:

Cap site; pump and treat groundwater to remove leachate and lower water table below wastes

Comparison to Hardage:

Similarities - similar wastes present

Differences - No drums are in the fill at GEMS. Geology makes groundwater management a feasible and effective method for intercepting seepage near the source, unlike at Hardage.

Remedial Elements:

At Hardage, drummed liquids are present in the fill and the underlying interbeded and fractured bedrock does not lend itself to groundwater management. These complicating factors make the remedy used at GEMS inappropriate for Hardage.

Helen Kramer Landfill Region #2 #4 on NPL

Mantua Township, New Jersey

- industrial waste landfill operated from 1970 to 1980
- 2 million cubic yards of waste
- all types of waste are present including drummed wastes
- the site is underlain by a shallow sand aquifer and a deeper aquitard.

Remedy:

Cap the fill; install a slurry wall upgradient and a collection trench downgradient, both with their base tied into the aquitard.

Comparison to Hardage:

Similarities - drummed and bulk wastes in industrial type fill

Differences Containment of the wastes directly beneath the site is feasible due to the presence of a barrier to vertical migration at Helen Kramer.

Remedial Elements:

The lack of a barrier to vertical migration at Hardage prevents effective containment in place as is possible at Helen Kramer.

Ponders Corner Region #10

Tacoma, Washington

- dry cleaner dumped sludges on the companies property
- solvents have contaminated groundwater
- sludge piles (sources) were previously removed by the State of Washington

Remedy:

Air stripping towers are in-place on municipal wells and are serving the dual purposes of groundwater collection and treatment; limited excavation with off-site is disposal planned for the most heavily contaminated soils.

Comparison to Hardage:

Similarities - solvent contaminated groundwater

Differences - Little of the source remains, most is dispersed into groundwater system or previously removed; collection and treatment of groundwater is feasible;

Remedial Elements:

The contaminant source at Ponders Corner has dispersed from it's original location, making source control inappropriate. For this reason the sites are not comparable.

Love Canal Region #2 #136 on NPL

Niagra Falls, New York

- abandoned canal was backfilled with industrial wastes and closed in 1952; 21,0 tons of wastes including drums are in the fill
- low-level contamination is present in several media
- canal excavated in sand overlying plastic clay and till; situation allows containment in place

Remedy:

Cap was upgraded; slurry walls installed, tied into clay layer; groundwater collection and on-site treatment system in-place; further studies are under way due to concern over vertical migration of leachate to bedrock and the possible inadequacy of in-situ containment.

Comparison to Hardage:

Similarites - drums in fill; similar contaminants

Differences - low-level contamination outside the canal as compared to Hardage; containment is feasible due to geology

Remedial Elements:

The shallow clay layer beneath Love Canal is thought to allow wastes to be contained beneath their original location; however, the adequacy of this layer is still being evaluated. The lack of such a layer at Hardage prevents consideration of such containment.

Sinclair Refinery Region #2 #117 on NPL

Wellsville, New York

- former refinery operation with two on-site landfills; soil was contaminated by spills
- fill contains principally bulk wastes
- small fill area (2 acres and 10-15 feet thick) is adjacent to a river and is being eroded; larger fill has a clay liner
- groundwater contamination is present but believed to result from spills on the site rather than releases from the landfills

Remedy:

Excavate the small fill areas, consolidate with the larger landfills and cap; groundwater will be addressed in other operable units

Comparison to Hardage:

Similarities - Removal is part of the EPA remedy on both sites.

Differences - Groundwater contamination is primarily from spills and already dispersed contaminants rather than the fill or concentrated source areas.

Remedial Elements:

The landfills at Sinclair are not leaking; at Hardage they are. For this reason, source control at Sinclair only needs to stabilize wastes against flooding and erosion. If necessary, groundwater management would likely be feasible in the river aquifer.

<u>Heleva Landfill</u> Region #3 #162 on NPL

North Whitehall Township, Pennsylvania

- low level solvents comingled with sanitary waste
- "source" of off-site contamination appears to be contaminated groundwater beneath the landfill itself
- little or no drummed waste is believed present

Comparison to Hardage:

Similarities - Similar contaminants observed off-site

Differences - Little free liquid appears present in the fill at Heleva, while a large source is present at Hardage. Since contaminants have generally left the Heleva fill, Source control is not appropriate

Remedy:

Capping with groundwater pumping and treatment

Remedial Elements:

At Heleva, the "source" of contamination has generally entered the groundwater system. This type of situation is best remedied by removing the contaminated groundwater. Since a large volume of free liquids is not present in the fill at Helelva, capping was assumed adequate to prevent further contamination of the groundwater. Such a system is not adequate at Hardage due to the physical differences between the sites noted above.

Lackawana Refuse Region #3 #453 on NPL

Old Forge Borough, Pennsylvania

- sanitary landfill operated through 1976; fill was in old coal pits
- 10,000 drums dumped in one pit over 4 months in 1976
- geology makes the groundwater contamination threat to the public miminal

Remedy:

Remove all drums from pit and dispose off-site; cap former pit area

Comparison to Hardage:

Similarities - drummed wastes present; removal is part of the EPA remedy

Differences - groundwater contamination is less extensive than at Hardage

Remedial Elements:

Hazardous materials will be removed from both sites; at Lackawana the municipal wastes will be capped. The remedies are consistent since, in both cases, the wastes will be excavated and properly disposed.

Taylor Borough Dump Region 3 #635 on NPL

Taylor Borough, Pennsylvania

- municipal/industrial landfill
- site consists of six distinct areas with varying degrees of contamination
- drums are present in some parts of the fill
- the decision on groundwater issues has been deferred to a later operable unit

Remedy:

Remove all drums; cap areas of surface contamination and municipal fill

Comparison to Hardage:

Similarities - drummed waste present; removal is part of the EPA remedy

Differences - surface contamination will be capped at Taylor, while its disposition at Hardage has not yet been determined.

Remedial Elements:

Concentrated areas of source materials have been or will be removed on both sites. The hazardous wastes at Hardage will be dealt with in the same general manner as were similar wastes at Taylor. For this reason, the remedies at both sites appears consistent.

Wauconda Sand & Gravel Region #5 #126 on NPL

Wauconda, Illinois

- municipal landfill operated from 1940s to 1979
- less than 3% of the 5 million cubic yards of waste is hazardous/industrial
- fill is in abandoned sand and gravel pit
- groundwater contamination is negligible

Remedy:

Interim remedy is a cap to prevent surface seepage into a nearby stream. Further study will be done on the groundwater operable unit.

Comparison to Hardage:

Similarities - Both sites have been split into operable units.

Differences - Hardage accepted almost exclusively industrial and hazardous wastes; Wauconda has only a very small percentage of this type waste. Groundwater has been contaminated at Hardage, unlike Wanconda.

Remedial Elements:

Factors making waste excavation necessary at Hardage are not present at Wauconda. Specifically, Hardage contains a large volume of hazardous substances which have been and continue to be released and extensive groundwater contamination is not a driving force behind remedial action at Wauconda. Source control and the cap are prinicpally directed at controlling surface seepage. Such differences make comparison of the sites difficult.

*New Lyme Landfill* *Region #5* *#626 on NPL*

Ashtabula County, Ohio

- municipal landfill which accepted industrial waste
- little is known on volume or types of waste
- little groundwater contamination
- if necessary, groundwater management is probably feasible

- groundwater discharge (up-flow) controls local hydrogeology and protects groundwater below fill

Remedy:

Construction of a RCRA compliant cap over the fill.

Comparison to Hardage:

Similarities - Relatively small amounts of some wastes disposed at Hardage are present at New Lyme

Diffences - Little groundwater contamination compared to Hardage site. No significant amounts of industrial waste was disposed at New Lyme.

Remedial Elements:

The groundwater flow system at New Lyme acts to prevent seepage out of the landfill. Since such a natural system is present, groundwater is not extensively contaminated and a large liquid/sludge source of contaminants is not present, source control is relatively straightforward. If necessary, groundwater management would likely be feasible unlike at Hardage. The sites are generally not comparable.

White House Waste Oil Pits Region #4 #132 on NPL

Whitehouse, Florida

- waste oil recycling facility
- Emergency Response cleaned out pits and capped the pit areas
- groundwater contamination present

Remedy:

Repair caps; install slurry wall and pump and treat groundwater.

Comparison to Hardage:

Similarities - groundwater contamination; waste removal was integral to remedy

Differences - waste source areas have already been removed at White House; and geology makes groundwater management feasible

R medial Elements:

T site remedies are quite similar. In both cases, the source areas were r oved. The capping and slurry wall at White House are similar to m sures which could be considered, for the second operable unit after t sources have bee removed.

Douglasville Disposal Region #3 #103 on NPL

Douglasville, Pennsylvania

- oil recycling facility;
- site is located adjacent to river and subject to flooding
- in previous actions, drums were removed; lagoons cleaned out and sludges land farmed on-site; spills have contaminated site
- groundwater and soils are contaminated
- river alluvium underlies site; slurry walls are feasibile to cut off lateral flows

Remedy:

Cap site; and build flood control levee; a slurry wall may be part of the groundwater remedy

Comparison to Hardage:

Similarity - groundwater and soil contaminated

Differences - former oil recycling facility; source areas have already been removed; groundwater management is feasible

Remedial Elements:

Source areas have been or will be removed on both sites; the remedies are consistent in that similar wastes are handled in a similar manner (i.e. excavate and treat hazardous wastes).

South Tacoma Channel (Commencement Bay) Region #10 #11 on NPL
Tacoma, Washington

- waste oil recycling and tank clean-out facility operated in 1960s
- filter cake containing tetrachloroethylene (PCE) was used as fill soil
- contaminants from spills are dispersed in the soil and underlying aquifer

Remedy:

Excavate hot spots of PCE and install vapor extraction points in the ground. Continue air-stripping water in a nearby municipal well.

Comparison to Hardage:

Similarites - groundwater contamination

Differences - source of contamination is spill areas which have already dispersed into the groundwater system; groundwater management is feasible.

Remedial Elements:

At South Tacoma, the waste is dispersed and source control is not applicable. The cap in this case has a very specific and limited purpose, to allow solvent vapor extraction.

Other comments related to the Feasibility Study process are as follows.

Comment: "A rotary kiln incinerator has the potential for incinerating the site wastes, but its feasibility has not been demonstrated." Process upset could result in the emission of dioxins and furans. The mixture of wastes present would pose problems over and above those associated with a costant waste stream.

Response: Incineration of the specific mixture of wastes present at Hardage has not yet been demonstrated. However, the types of waste present have generally been destroyed in this manner. The problems cited contribute to the cost of over $300 million estimated for incineration alternatives. Bench tests and possibly pilot studies would be essential to the remedial design as would be emissions testing.

EPA considers incineration on virtually all Superfund sites where organic contamination exists. It is never stated that the construction and operation of an incinerator would be simple, only that at this point it appears feasible, and warrants consideration due to it's benefits.

Comment: Incinerator ash may be eligible for de-listing as a RCRA hazardous waste on a site specific basis.

Response: If treatment of ash removes the characteristics of a hazardous waste (primarilly EP Toxicity in this case), the ash may be eligible for delisting. Based on a risk-assesment, delisting could be considered after it is demonstrated that the above criteria could be met.

Comment: On-site incineration provides no time advantage over off-site incineration, since the off-site treatment won't take 10 years as assumed in the FS.

Response: The 10 year figure was based on current backlogs for existing units. While capacity may increase in the future demand will also increase. Reduction of the 10 year figure is not warranted at this time.

Comment: Groundwater recovery (pumping) would be feasible in the bedrock and should not have been eliminated from consideration.

Response: The commenter has ignored the extensive data collected indicating fracture zones, uniformly low yield, and the fact that wells pumping from fractured bedrock will produce a small cone of depression. For this reason, withdrawl wells would have to be closely spaced and very deep, creating an large quantity of

Although the system would still allow substantial releases as described in the FS, groundwater recovery by withdrawl from a collection trench system as described in Alternatives 4 and 5, was deemed feasible.

Comment: Technologies for reuse or recycling of waste should have been considered, particullarly "Basic Extraction Solvent Technology" (BEST) as employed on the Savanaha site in Georgia.

Response: As noted in the FS, the extreme variability of the wastes at Hardage virtually eliminates the use of known reuse/recycle alternatives. Solvents Extraction is quite useful where wastes are homogerous liquids. However, the waste stream at Hardage is highly varied and much is a high density sludge. The application of solvent extraction to high solids content wastes will only result in a minimal reduction in volume to be dealt with. Reuse/recycle treatments will be considered for certain wastes if technologies become apparent or are developed.

Comment: If the site had been operated after 1980 then capping would have been an acceptable measure for closure under RCRA. Yet EPA states that capping is not viable enough to even consider as an acceptable remedy.

Response: The site was not operated after November 1980, partially due to the operators inability to meet new requirements for hazardous waste land disposal facilities which went into effect at that time. Facilities which legally operated after November 1980 presumably were better managed with at least some safeguards built in. In some cases this may make capping adequate for containing the wastes. The Hardage facility had no such safeguards and bedrock has been found to provide inadequate barriers; therefore, simple closure in-place is not acceptable. (Note: The commenter went on to argue against the application of other provisions of RCRA as applicable or relevant and appropriate requirements).

Comment: The factors used to screen all alternatives and eliminate several were inconsistent with those dictated by the NCP. If the appropriate factors had been applied, then the FS might have reached different conclusions.

Response: Section 300.68(g) of the NCP states that, "Three broad criteria shall, as appropriate, be used in the initial screening of alternatives." The three "broad" factors to be used are cost, acceptable engineering practice, and effectiveness. The ranking factors used in screening of alternatives in the FS were:

reliability, implementability, safety, environmental, institutional and cost. The factors considered fell in the broad categories listed in the NCP and are consistent with the screening factors listed in EPA's FS guidance.

Comment: The alternatives which should have been retained for further consideration in the FS were Alternatives: #3-Capping, #5-capping with perimeter drains, #7-On-site landfill, and #10 Off-site disposal.

Response: The commenter suggest considering two alternatives which EPA rejected (#3-Capping and #5- Capping with Perimeter Drains). Documentation for rejection of alternatives numbered 3 and 5 is provided in the FS on page 3-27,28 and 3-29,30 respectively. The principal reason for rejecting these alternatives is their inability to significantly reduce the release of leachate into the groundwater system.

The commenter also suggest rejecting two alternatives which EPA retained (#8- On-Site Incineration and Disposal and #9-On-Site Incineration/Offsite Disposal). EPA disagrees with the commenter. Congress, in the 1984 ammendments to RCRA, has determined that land disposal of soils contaminated with certain wastes, including many solvents, should be banned, although a two year extension is provided for CERCLA response actions. Prior to such regulation, some facilities may be hesitant to accept a large volume of waste with bans pending on it. Destruction of organics is an enormous benefit, in that the destroyed compounds will no longer be capable of posing threats to the public or environment.

EPA is specifically directed by the NCP to consider alternatives exceeding requirements. Incineration falls into this category and the benefits may prove commensurate with the costs; therefore consideration of incineration is appropriate.

Comment: The adverse effects of waste excavation were not considered. These may pose unacceptable environmental impacts and be grounds for selecting an in-situ alternative not meeting requirements.

Response: The hazards associated with excavating the site were recognized in the FS. It is believed that releases to all media except air, can be readily controlled. Releases to air will be minimized by dust control measures, handling and excavation techniques aimed at minimizing the volume of waste in the open at any given time, and possibly placement of a temporary structure over the waste excavation. Air monitoring will be performed and the potential threat to adjacent residents will be monitored throughout operations as will be the potential need for their immediate evacuation. Threats to workers are real; but this is the reason for extensive safety precautions and health monitoring.

Comment: A risk assesment should have been performed on the Hardage site.

Response: A preliminary Public Health Assessment has been prepared and will be supplemented as further data is obtained.

Comment: The detailed developement and analysis of alternatives presented in the FS is inadequate and may not allow selection of the most appropriate remedy from the four finalists.

Response: Section 300.68(h)(2) of the NCP sets out the factors to be included, as appropriate, in the detailed analysis. These factors are: 1) refinement and specification of alternatives; 2) detailed cost estimate; 3) engineering evaluation of effectivness, implementability, and constructability; 4) assessment of effectiveness of remedy in meeting remedial objectivies; 5) analysis of alternate technologies; 6) analysis of costs of adverse impacts and their mitigation.

These factors were addressed, as appropriate, and alternatives were refined in sufficient detail to allow selection of an appropriate remedy. The development is not to a design level, but it is not intended to be.

Comment: The findings of fact and conclusions of law arrived in 1982 by the U.S. District Court in Oklahoma City concerning the site should not have been relied upon to develope a remedy.

Response: The findings and conclusions were not used in the FS in the manner that the commenter suggested was the case. The facts which led to development of these findings and conclusions have for the most part been supported by data obtained since 1982, and have therefore been properly considered, along with other relevant investigative and factual information concerning the site. EPA did not mean to imply that these findings and conclusions had to be taken at face value, as they certainly were not during the FS but were re-examined as appropriate.

E) OPPORTUNITY FOR PUBLIC PARTICIPATION

Comments were received which indicate some parties feel EPA should have made a greater effort to involve those parties potentially liable for the site in development of the FS and should have allowed more extensive comments on the FS. The NCP as well as current EPA policy is cited as support for this argument.

Where appropriate, EPA will generally involve PRPs in studies and development of response actions. The reasons for this are numerous, not the least of which is the previous experience of the Agency which suggests that those parties most directly involved in studies and most familiar with the rationale for EPA decisions will be most willing to participate in voluntary clean up. At the Hardage/Criner site, the enforcement policy documents which recommend PRP participation in the RI/FS were appropriate, had not been promulgated by EPA at the time the FS was committed. In addition, a PRP search had not yet been completed. For this reason, PRPs were not involved from the outset. In December 1984, an initial group of nearly 300 PRPs was notified of their potential liability on the site. Since that time, approximately 135 parties have formed the Hardage Steering Committee (HSC).

EPA has met with HSC often since its formation. Final documents have been provided in a timely manner; and over 200 requests for documents and information have been answered in writing under the Freedom of Information Act since early 1985. Communication has been frequent between both the technical and legal staffs and have been as open as the enforcement nature of the site allows.

Comment: EPA refused to afford HSC the opportunity to participate in development of the RI/FS. These actions violated EPAs own guidelines including the March 20, 1984 memo from Lee Thoms, "Participation of PRPs in development of RI/FS under CERCLA and the draft CERCLA Settlement Policy".

Response: The March 20, 1984 memo indicates that PRPs may be allowed, to where appropriate, to conduct the RI/FS under an EPA approved scope of work and under a formalized agreement such as a Consent Decree. This policy in no way requires or indicates that EPA will abandon on-going studies merely to allow PRP conduct of an RI/FS. Regional experience has been that when conduct of an RI/FS has been switched from one EPA contractor to another, significant delays result. Even greater delays would be expected in transfer of the RI/FS to a party out-side the Agency. In addition, previous activities of HSC have not indicated that an FS could have been completed by them more rapidly than by EPA. The Hardage Steering Committee had not been organized at the time the FS was initiated in January 1984; aside from this purley practical reason for not allowing HSC to conduct an RI/FS, other factors enter into this situation.

The draft "CERCLA Settlement Policy" referenced to in the comment was issued October 4, 1985, and does not constitute EPA policy. Instead, EPA's settlement policy is contained in the Interim CERCLA Settlement Policy as set forth in the Federal Register on January 5, 1986. At this time the FS was in its later stages of development.

Comment: Insufficient time was allowed for comment on the FS. The document is extensive and detailed, thus a comment period substantially longer than the minimum three weeks required by the NCP would have been appropriate.

Response: There was a 5 week comment period on the FS; this included a 15 day extension requested by HSC. addition, the FS was placed in repositories and provided to the HSC two weeks before the formal comment period began, providing a total of approximately seven weeks for interested parties to review and comment on the FS. While EPA and its contractor did spend approximately eight months compiling the 200 page FS, all data from which this FS was compiled has been available to the public from the time EPA began the FS in mid-1985.

Comment: EPA must afford the HSC an opportunity to finalize and present its own response plan before selecting a remedy.

Response: EPA has repeatedly been told that HSC is or will be preparing some type of response plan. Unfortunantely this work has never been produced, forcing EPA into the conclusion that such work may not be done even if EPA were to wait. Any response plan submitted to EPA will be considered, as have all proposals, documents, advice, and comments in the past, provided such a plan is received in a timely fashion. EPA guidlines and regulations do not, as the commenter states, require EPA to afford the HSC an opportunity to finalize and present this plan.

F) RECOMMENDATION FOR ADDITIONAL STUDY AND/OR INITIAL REMEDIAL MEASURES

The commenters have proposed a general plan for additional studies which in their opinion, should be conducted prior to selection of a remedy for the site. These studies would supplement EPA work and be aimed at developing a RI/FS for both operable units of the site.

These commenters have also proposed to conduct initial measures aimed at site stabilization. These measures would mainly included:

1) fencing of the entire property,

2) construction of a temporary cap and collection system for surface seeps

3) monitoring of drinking water supplies and construction of alternate water supplies if necessary.

EPA feels that some of the study items suggested by the commenters are appropriate. Some of the additional study items and are being considered by EPA as necessary components of studies for the second operable unit. EPA sees no purpose in rethinking its previous decision to split the site into operable units.

The proposed "removal" actions have also been considered by EPA. An EPA site assessment team was dispatched to the site in June 1986 and, following the teams report, action will be taken as necessary.

G) OTHER COMMENTS

Comment: Has EPA considered incineration and disposal of the entire waste volume at Hardage through underground injection. In this area, formations below 3000 feet often show caverns which take enormous amounts of fluids and cannot be plugged by addition of sealant or bridging materials.

Response: Two problems would be presented by disposing wastes in the fashion suggested: the actual ability to do this and the legal and permitting constraints.

The physical problems with injection would be significant. The volume of waste considered for disposal is roughly 179,000 cubic yards, or 36 million gallons, of soils and sludge. To allow injection, the waste would have to be slurried with water, forming a volume in exess of 100 million gallons of waste slurry. While this volume could theoretically be injected in the space of a few weeks, the enormous volume of solids would likely clog cavities rapidly, requiring construction of several wells over an area significantly larger than the site.

Considering the type of waste found at Hardage, it is unlikely such injection wells would be permitted by EPA or the State of Oklahoma.

Comment: EPA should select the On-site incineration/Off-site Disposal Alternative. This is the only way to achieve a permanent remedy for the Hardage site. Several commentors expressed this sentiment; one felt that the On-site incineration and disposal plan would also be adequate.

Response: EPA favors an on-site disposal plan due to several factors including:
1) the volume of waste present;
2) hazards associated with off-site transport;
3) questionable availability of an off-site disposal facility; and
4) the fact that an off-site plan merely shifts hazards to another location and population.

EPA will give appropriate consideration to the incineration options. The decision will be available for public comment before being finalized as a Record of Decision.

Comment: Incinceration should not be selected since 100% destruction of compounds such as 2,3,7,8 - tetrachlorodibenzo -p-dioxin (TCDD) cannot be achieved. In addition, particulates should be sampled prior to emmission to the air.

Response: 100% destruction of anything can never be achieved. Incinerator testing by EPA in Missouri has in all cases achieved greater than 99.9999% destruction of TCDD and has effectively destroyed even hard to burn compounds such as carbon tetrachloride. EPA sets limits on particulate emissions by incinerators and these solids would be analyzed in test burns and periodically throughout the operations.

Comment: The waste could be disposed as follows:

- seperate water/solids by settling
- dispose the water in an injection well
- heat the solids to dry them
- seal the solids in a plastic/cement "casket" and bury
- dispose the dirt in another manner

This plan is, in some ways, similar to the on-site disposal option. The waste treatment and handling techniques have not yet been finalized. These comments and plans will be considered in the design phase of remedial planning.

Comment: Do provisions exist for indemnifying contractors involved in remedial work on Superfund sites from possible future liability under CERCLA for hazards arising from the site at some time after this work is completed.

Response: Under current law, the contractor cannot be indemnified even for actions carried out at EPAs direction. Provisions for contractor indemnification will likely be in revised CERCLA statutes being developed Congress.

Comment: EPA should have more thoroughly investigated deep bedrock to identify existing contamination and evaluate the potential for contamination in the future. This needs to be done since it is contamination of deeper ground water and transport through that flow regime which has the potential to affect populations not in the immediate vicinity on the site.

Response: One of the key purposes of the Management of Migration RI/FS will be to define the long-term potential for migration along pathways such as the deeper groundwater. Three wells drilled on-site to depths of 200 feet or more showed no contaminants at detectable leve s.

APPENDIX G

DETAILED COST ESTIMATE FOR THE SELECTED REMEDY

# PRELIMINARY

HARDAGE INDUSTRIAL WASTE SITE
CRINER, OKLAHOMA
EPA REMEDY WITH EXCAVATION OPTION

| ITEM | QUANTITY | UNIT MEASURE | UNIT COST | EXTENDED COST | |
|---|---|---|---|---|---|
| Section 3 - DETAILED REMEDY DESCRIPTION | | | | | |
| 3.1 Source Removal & Control | | | | | |
| 3.1.1 Liquids Removal and Disposal | | | | | |
| DRUM REMOVAL | | | | | |
| Equipment | | | | | |
| Tracked Excavator (1-CY) | 16 | MOS | $5,650 | $90,400 | |
| Tracked Excavator (2-CY) | 16 | MOS | 8,000 | 128,000 | |
| Vacuum Truck | 16 | MOS | 11,040 | 176,640 | |
| Forklift (2 units) | 32 | MOS | 1,517 | 48,544 | |
| Backhoe (2 units) | 32 | MOS | 2,725 | 87,200 | |
| Dump Trucks (6 units) | 96 | MOS | 3,050 | 292,800 | |
| Flat Bed Truck (2 units) | 32 | MOS | 755 | 24,160 | |
| Pickup Truck (2 units) | 32 | MOS | 510 | 16,320 | |
| Support Equipment | 1 | LS | 112,000 | 112,000 | |
| Air Emissions Control | | | | | |
| Equipment | 32 | MOS | 1,000 | 32,000 | |
| Material | 368 | DAYS | 300 | 110,400 | |
| Labor | | | | | |
| Foreman (16hr/day x 2 men) | 11,776 | HRS | 35.00 | 412,160 | |
| Equip Operators (16 hr/day x 6 men) | 35,328 | HRS | 31.50 | 1,112,832 | |
| Truck Drivers (16 hr/day x 6 men) | 35,328 | HRS | 25.60 | 904,397 | |
| Laborer (16hr/day x 2 men) | 35,328 | HRS | 24.60 | 869,069 | |
| Industrial Hygiene Tech (16 hr/day x 2 men) | 11,776 | HRS | 32.00 | 376,832 | |
| Health/Safety Equipment | | | | | |
| - Class A | 7,360 | MN-DY | 135.00 | 993,600 | |
| - Class B | 8,832 | MN-DY | 75.00 | 662,400 | |
| Total | | | | | $6,449,754 |
| DRUMMED WASTE STAGING/CONSOLIDATION AREA | | | | | |
| Site Grading | 2,047 | CY | $0.96 | $1,965 | |
| Building | | | | | |
| Concrete Slab | 185 | CY | 180 | 33,300 | |
| Drum Opening Area | 1 | LS | 14,000 | 14,000 | |
| Roof Covering | 10,000 | SF | 5.15 | 51,500 | |
| Sump Areas | 1 | LS | 30,000 | 30,000 | |
| Conveyor Racks | 210 | LF | 48 | 10,080 | |
| Equipment | 1 | LS | 182,800 | 182,800 | |

# PRELIMINARY

HARDAGE INDUSTRIAL WASTE SITE
CRINER, OKLAHOMA
EPA REMEDY WITH EXCAVATION OPTION

| ITEM | QUANTITY | UNIT MEASURE | UNIT COST | EXTENDED COST | |
|---|---|---|---|---|---|
| Section 3 - DETAILED REMEDY DESCRIPTION | | | | | |
| 3.1 Source Removal & Control | | | | | |
| 3.1.1 Liquids Removal and Disposal | | | | | |
| DRUMMED WASTE STAGING/CONSOLIDATION AREA - Continued | | | | | |
| Labor | | | | | |
| Foreman | 8,832 | HRS | 35.00 | 309,120 | |
| Tech - Level 1 (16 hrs) | 8,832 | HRS | 24.60 | 217,267 | |
| Tech - Level 1 (8 hrs) | 4,416 | HRS | 24.60 | 108,634 | |
| Health/Safety Equipment | 1 | LS | 289,800 | 289,800 | |
| Maintenance | 1 | LS | 11,400 | 11,400 | |
| Disposal of Organics | | | | | |
| Transportation (150 trips) | 75,000 | MI | 3.75 | 281,250 | |
| Incineration | 300,000 | GALS | 4.04 | 1,212,000 | |
| Disposal of Drums | 1 | LS | 1,300 | 1,300 | |
| Closure | 1 | LS | 39,200 | 39,200 | |
| Total | | | | | 2,791,616 |
| REMOTE STORAGE AREA | | | | | |
| Remote Storage Area | 1 | LS | $19,900 | $19,900 | 19,900 |
| 3.1.4 Soil Vapor Extraction | | | | | |
| SOIL VAPOR EXTRACTION | | | | | |
| Sitework | 1 | LS | $10,000 | $10,000 | |
| Buildings | | | | | |
| Blower Building | 2,160 | SF | | 90,000 | |
| Equipment | | | | | |
| Blower - 9,000cfs | 5 | EA | 41,000 | 205,000 | |
| Tank - 2,000gal | 1 | EA | 6,000 | 6,000 | |
| Piping | 1 | LS | | 600,000 | |
| Monitoring Probes | 100 | EA | 900 | 90,000 | |

# PRELIMINARY

HARDAGE INDUSTRIAL WASTE SITE
CRINER, OKLAHOMA
EPA REMEDY WITH EXCAVATION OPTION

| ITEM | QUANTITY | UNIT MEASURE | UNIT COST | EXTENDED COST | |
|---|---|---|---|---|---|
| Section 3 - DETAILED REMEDY DESCRIPTION | | | | | |
| 3.1 Source Removal & Control | | | | | |
| 3.1.4 Soil Vapor Extraction | | | | | |
| SOIL VAPOR EXTRACTION - Continued | | | | | |
| SUBTOTAL - Known Costs Only | | | | $1,001,000 | |
| General Conditions @ | 5% of SUBTOTAL | | | 67,635 | |
| Finishes @ | 1% of SUBTOTAL | | | 13,527 | |
| Electrical @ | 10% of SUBTOTAL | | | 135,270 | |
| Instrumentation & Controls @ | 5% of SUBTOTAL | | | 67,635 | |
| Yard Piping @ | 5% of SUBTOTAL | | | 67,635 | |
| SUBTOTAL - Percentage Costs Only = 26% of SUBTOTAL | | | | | |
| SUBTOTAL - Known and Percentage Costs Only | | | | $1,352,703 | |
| Mobilization @ 5% of SUBTOTAL - Known + % | | | | 67,635 | |
| Pilot Studies | 1 | LS | 550,000 | 550,000 | |
| SVE Start-up Services | 1 | LS | 30,000 | 30,000 | |
| Subtotal | | | | | $2,000,338 |
| AIR TREATMENT | | | | | |
| Sitework | 1 | LS | | $10,000 | |
| Concrete | | | | | |
| Slab on Grade | 267 | CY | 200 | 53,400 | |
| Equipment | | | | | |
| LP Tank - 18,000gal | 1 | EA | 16,000 | 16,000 | |
| Blower | 2 | EA | 38,500 | 77,000 | |
| Thermal Oxidation Unit | 1 | EA | 612,000 | 612,000 | |
| SUBTOTAL - Known Costs Only | | | | $768,400 | |
| General Conditions @ | 5% of SUBTOTAL | | | 54,886 | |
| Electrical @ | 10% of SUBTOTAL | | | 109,771 | |
| Instrumentation & Controls | 5% of SUBTOTAL | | | 54,886 | |
| Yard Piping | @ 10% of SUBTOTAL | | | 109,771 | |
| SUBTOTAL - Percentage Costs Only = 70% of SUBTOTAL | | | | | |
| SUBTOTAL - Known and Percentage Costs Only | | | | $1,097,714 | |
| Subtotal | | | | | 1,097,714 |

# PRELIMINARY

HARDAGE INDUSTRIAL WASTE SITE
CRINER, OKLAHOMA
EPA REMEDY WITH EXCAVATION OPTION

| ITEM | QUANTITY | UNIT MEASURE | UNIT COST | EXTENDED COST |
|---|---|---|---|---|
| Section 3 - DETAILED REMEDY DESCRIPTION | | | | |
| 3.1 Source Removal & Control | | | | |
| 3.1.5 Adjacent Source Removal | | | | |
| REMOVAL OF ADJACENT WASTES | | | | |
| North Pond Area | | | | |
| Excavation | 5,800 | CY | $45.15 | $261,870 |
| Placement under cap | 5,800 | CY | 11.77 | 68,266 |
| Drum remediation | | | | |
| Transport | 750 | MI | 3.75 | 2,813 |
| Incineration | 1,485 | BBL | 4.04 | 5,999 |
| West Pond Area | | | | |
| Exc/Haul/Placement | 63,200 | CY | 17.29 | 1,092,728 |
| U trench | | | | |
| Exc/Haul/Placement | 2,704 | CY | 16.54 | 44,724 |
| V trench | | | | |
| Exc/Haul/Placement | 11,085 | CY | 16.54 | 183,346 |
| SW trench | | | | |
| Exc/Haul/Placement | 1,275 | CY | 16.54 | 21,089 |
| East Farm Pond #2 (HBC) | 1 | LS | 171,000 | 171,000 |
| East Farm Pond #2 (HBC) | 1 | LS | 317,000 | 317,000 |
| REMEDY TOTAL | | | | $2,168,834 |

PRELIMINARY

HARDAGE INDUSTRIAL WASTE SITE
CRINER, OKLAHOMA
EPA REMEDY WITH EXCAVATION OPTION

| ITEM | QUANTITY | UNIT MEASURE | UNIT COST | EXTENDED COST |
|---|---|---|---|---|
| Section 3 - DETAILED REMEDY DESCRIPTION | | | | |
| 3.1 Source Removal & Control | | | | |
| 3.1.6 Source Area Capping | | | | |
| SITE CAPS | | | | |
| Stormwater Berm | 4,000 | LF | $4.00 | $16,000 |
| Retention Basin | 1 | LS | 10,000 | 10,000 |
| Clean Soil Placement | 5,800 | CCY | 14.84 | 86,072 |
| Permanent Cap | | | | |
| Remove Wells | 400 | EA | 100.00 | 40,000 |
| Remove Piping & Wells | 400 | EA | 20.00 | 8,000 |
| Scalp Grass | 33.10 | AC | 50.00 | 1,655 |
| Disc 6" | 72,957 | SY | 0.19 | 13,862 |
| 24" Clay | 59,160 | CCY | 14.84 | 877,934 |
| 80 mil HDPE | 88,737 | SY | 7.20 | 638,906 |
| 12" Sand | 29,580 | CCY | 15.84 | 468,547 |
| Strip Drains | 1 | LS | 38,830.00 | 38,830 |
| Collection Pipe | 1 | LS | 1,680.00 | 1,680 |
| Geotextile | 88,737 | SY | 1.20 | 106,484 |
| 12" Granular Material | 29,580 | CCY | 25.00 | 739,500 |
| Geotextile | 88,737 | SY | 1.20 | 106,484 |
| 18" Native Soil | 44,369 | CCY | 5.13 | 227,613 |
| 6" Topsoil | 14,790 | CCY | 14.81 | 219,040 |
| Geomatrix | 58,670 | LS | 1.55 | 90,939 |
| Vegetative Cover | 88,737 | LS | 0.35 | 31,058 |
| REMEDY TOTAL | | | | $3,722,605 |

# PRELIMINARY

HARDAGE INDUSTRIAL WASTE SITE
CRINER, OKLAHOMA
EPA REMEDY WITH EXCAVATION OPTION

| ITEM | QUANTITY | UNIT MEASURE | UNIT COST | EXTENDED COST |
|---|---|---|---|---|
| Section 3 - DETAILED REMEDY DESCRIPTION | | | | |
| 3.2 Groundwater Extraction & Treatment | | | | |
| 3.2.1 Groundwater Trenches | | | | |
| GROUNDWATER COLLECTION TRENCHES - Continued | | | | |
| V-SHAPED TRENCH | | | | |
| Mobilization | 1 | LS | $20,000 | $20,000 |
| Soil Excavation | 11,400 | CY | 2.07 | 23,598 |
| Borehole dia (3") 77 holes | 4,042 | FT | 66.40 | 264,389 |
| Borehole dia (2") 836 holes | 43,890 | FT | 36.95 | 1,621,736 |
| Remove Ribs | 5,358 | CY | 20.25 | 108,500 |
| Insert end pipes (77 holes x 53.5 FT/hole) | 4,120 | FT | 161.05 | 663,526 |
| Place coarse gravel | 633 | CY | 35.00 | 22,155 |
| Place medium sand | 9,819 | CY | 15.92 | 156,318 |
| Place soil liner | 633 | CY | 16.50 | 10,445 |
| Replace subgrade to grade | 11,400 | CY | 2.48 | 28,272 |
| Withdrawal wells (6 each) | | | | |
| Pumps | 6 | EA | 1,265.00 | 7,590 |
| Electric cables | 3,330 | LF | 2.00 | 6,660 |
| Teflon discharge hoses to piping | 330 | LF | 3.00 | 990 |
| Collection Lines | | | | |
| Trench lines | 2,900 | LF | 5.83 | 16,907 |
| Lateral to Plant | 100 | LF | 9.89 | 989 |
| Trenching cost (Excavation & Backfill) | 3,000 | LF | 1.75 | 5,250 |
| Pump controllers | 1 | LS | 5,000 | 5,000 |
| Withdrawal Wells | | | | |
| P.E. Screen (6 inch dia) | 60 | FT | 20.00 | 1,200 |
| P.E. Casing (6 inch dia) | 303 | LF | 16.50 | 5,000 |
| Protective casing | 6 | EA | 250.00 | 1,500 |
| Course Sand Backfill | 77 | CY | 15.92 | 1,226 |
| Low Perm Soil Backfill | 5 | CY | 20.00 | 100 |
| Labor | 1 | LS | 6,780.00 | 6,780 |
| Observation Wells (71 each) | | | | |
| P.E. Screen (4 inch dia x 10 LF/well) | 710 | LF | 6.10 | 4,331 |
| P.E. Casing (4 inch dia x 50 LF/well) | 3,586 | LF | 4.17 | 14,954 |
| Gravel Fill (71 wells) | 970 | CY | 15.92 | 15,442 |
| Low Perm Soil Backfill | 56 | CY | 20.00 | 1,120 |
| Protective casing | 71 | EA | 150.00 | 10,650 |
| Labor | 1 | LS | 8,970.00 | 8,970 |
| Sub Subtotal | | | | 3,037,596 |

# PRELIMINARY

HARDAGE INDUSTRIAL WASTE SITE
CRINER, OKLAHOMA
EPA REMEDY WITH EXCAVATION OPTION

| ITEM | QUANTITY | UNIT MEASURE | UNIT COST | EXTENDED COST |
|---|---|---|---|---|
| Section 3 - DETAILED REMEDY DESCRIPTION | | | | |
| 3.2 Groundwater Extraction & Treatment | | | | |
| 3.2.1 Groundwater Trenches | | | | |
| GROUNDWATER COLLECTION TRENCHES - Continued | | | | |
| SOUTHWEST TRENCH | | | | |
| Mobilization | 1 | LS | $20,000 | $20,000 |
| Soil Excavation | 2,400 | CY | 2.07 | 4,968 |
| Borehole dia (3")- 17 ea | 488 | FT | 66.40 | 32,403 |
| Borehole dia (2")- 176 ea | 5,051 | FT | 36.95 | 186,634 |
| Remove Ribs | 599 | CY | 20.25 | 12,130 |
| Insert end pipes (17 @ 30' | 510 | FT | 161.05 | 82,136 |
| Place coarse gravel | 134 | CY | 35.00 | 4,620 |
| Place medium sand | 1,008 | CY | 15.92 | 16,047 |
| Place soil liner | 134 | CY | 16.50 | 2,211 |
| Replace subgrade to grade | 2,400 | CY | 2.48 | 5,952 |
| Withdrawal wells | | | | |
| Pumps | 2 | EA | 1265.00 | 2,530 |
| Electric cables | 760 | LF | 2.00 | 1,520 |
| Teflon discharge hoses to piping | 60 | LF | 3.00 | 180 |
| Collection Lines | | | | |
| Trench Lines | 600 | LF | 5.83 | 3,498 |
| Lateral to Plant | 1,200 | LF | 9.89 | 11,868 |
| Trenching Cost (Excavation & Backfill) | 1,800 | LF | 1.75 | 3,150 |
| Pump controllers | 1 | LS | 5,000.00 | 5,000 |
| In-line pump to transport over 8" line | 1 | LS | 5,000.00 | 5,000 |
| Withdrawal Wells | | | | |
| P.E. Screen (6 inch dia) | 20 | FT | 20.00 | 400 |
| P.E. Casing (6 inch dia) | 74 | LF | 16.50 | 1,221 |
| Protective casing | 2 | EA | 250.00 | 500 |
| Course Sand Fill | 13 | CY | 15.92 | 207 |
| Low Perm Soil Backfill | 2 | CY | 20.00 | 40 |
| Labor | 1 | LS | 1,620.00 | 1,620 |
| Observation Wells (15 each) | | | | |
| P.E. [illegible]een(4" x 10'/ea) | 150 | LF | 6.10 | 915 |
| P.E. Casing(4" x 27'/ea) | 400 | LF | 4.17 | 1,668 |
| C Sand Fill (15 wells) | 101 | CY | 15.92 | 1,608 |
| Low Perm Soil Backfill | 12 | CY | 20.00 | 240 |
| Protective casing | 15 | EA | 150.00 | 2,250 |
| Labor | 1 | LS | 2,000.00 | 2,000 |
| Sub Subtotal | | | | 387,618 |

# PRELIMINARY

HARDAGE INDUSTRIAL WASTE SITE
CRINER, OKLAHOMA
EPA REMEDY WITH EXCAVATION OPTION

| ITEM | QUANTITY | UNIT MEASURE | UNIT COST | EXTENDED COST | |
|---|---|---|---|---|---|
| Section 3 - DETAILED REMEDY DESCRIPTION | | | | | |
| 3.2 Groundwater Extraction & Treatment | | | | | |
| 3.2.1 Groundwater Trenches | | | | | |
| GROUNDWATER COLLECTION TRENCHES - Continued | | | | | |
| MISCELLANEOUS ITEMS | | | | | |
| Reserve Pumps, cables, Discharge hoses | 1 | LS | $3,080 | $3,080 | |
| Generators | 5 | EA | 5,000 | 25,000 | |
| Sub Subtotal | | | | 28,080 | |
| Subtotal | | | | | $3,453,294 |
| 3.2.2 Groundwater Treatment | | | | | |
| GROUNDWATER TREATMENT | | | | | |
| Effluent Pond | | | | | |
| Excavation | 5,000 | CY | $3 | $15,000 | |
| Backfill | 5,000 | CY | 5 | 25,000 | |
| Spillway | 1 | LS | 10,000 | 10,000 | |
| Weir 3' high | 1 | LS | 5,000 | 5,000 | |
| Recycle Line | | | | | |
| 4" HDPE Pipe | 1,000 | LF | 15 | 15,000 | |
| Equipment | | | | | |
| Tanks - 15,000gal | 1 | EACH | $30,000 | $30,000 | |
| Mixers - 1 Hp | 4 | EACH | 12,000 | 48,000 | |
| Pumps - Diaphragm 1/2hp | 2 | EACH | 600 | 1,200 | |
| Oil/Water Separators | 2 | EACH | 10,000 | 20,000 | |
| Oil Pump | 2 | EACH | 1,200 | 2,400 | |
| Solids Pump | 2 | EACH | 7,800 | 15,600 | |
| Package Treatment System —Metals | 2 | EACH | 85,000 | 170,000 | |
| Lime Feed System | 3 | EACH | 4,630 | 13,890 | |
| Settler - Second | 6 | EACH | 20,000 | 120,000 | |
| Sludge Pump | 3 | EACH | 1,200 | 3,600 | |
| Media Filter | 2 | EACH | 28,000 | 56,000 | |
| Effluent Pump | 2 | EACH | 600 | 1,200 | |
| Effluent Tank | 2 | EACH | 25,000 | 50,000 | |
| Acid Metering System | 2 | EACH | 4,630 | 9,260 | |
| Backwash Pump | 2 | EACH | 800 | 1,600 | |
| Backwash Storage Tank | 1 | EACH | 20,000 | 20,000 | |
| Decant Pump | 1 | EACH | 600 | 600 | |
| Sludge Pump - BW | 2 | EACH | 1,200 | 2,400 | |
| Stripper Pump | 2 | EACH | 800 | 1,600 | |

# PRELIMINARY

HARDAGE INDUSTRIAL WASTE SITE
CRINER, OKLAHOMA
EPA REMEDY WITH EXCAVATION OPTION

| ITEM | QUANTITY | UNIT MEASURE | UNIT COST | EXTENDED COST |
|---|---|---|---|---|
| Section 3 - DETAILED REMEDY DESCRIPTION | | | | |
| 3.2 Groundwater Extraction & Treatment | | | | |
| 3.2.2 Groundwater Treatment | | | | |
| GROUNDWATER TREATMENT - Continued | | | | |
| Equipment - Continued | | | | |
| Air Strippers | 2 | EACH | 50,000 | 100,000 |
| Air Blower | 2 | EACH | 2,000 | 4,000 |
| GAC - Water | 4 | EACH | 20,000 | 80,000 |
| Str. Effl. Pump | 2 | EACH | 800 | 1,600 |
| Sludge Storage Tank | 1 | EACH | 10,000 | 10,000 |
| Sludge Mixer | 1 | EACH | 12,000 | 12,000 |
| Filter Press | 2 | EACH | 35,000 | 70,000 |
| Filter Press Pump | 2 | EACH | 1,200 | 2,400 |
| Tank - D. E. | 1 | EACH | 3,000 | 3,000 |
| D. E. Mixer | 1 | EACH | 1,200 | 1,200 |
| Filtrate Tank | 1 | EACH | 3,000 | 3,000 |
| Filtrate Pump | 1 | EACH | 600 | 600 |
| Emergency Generator - 60KW | 1 | EACH | 25,000 | 25,000 |
| Sump Pump | 3 | EACH | 1,200 | 3,600 |
| Air Compressor | 1 | EACH | 12,500 | 12,500 |
| Piping to Pond | 1 | LS | 15,000 | 15,000 |
| Emergency Shower & Eyewash | 1 | EACH | 1,000 | 1,000 |
| Operations/Maint Manual | 1 | EACH | 10,000 | 10,000 |
| Batch Treatment Equipment | 1 | EACH | 100,000 | 100,000 |
| Labor | | | | |
| Operator (16 hrs) | 5,336 | HRS | 31.50 | 168,084 |
| Operator (8 hrs) | 5,336 | HRS | 31.50 | 168,084 |
| Health & Safety Equipment | 1 | LS | 143,420 | 143,420 |
| Closure | 1 | LS | 10,900 | 10,900 |
| SUBTOTAL - Known Costs Only | | | | $1,582,738 |
| General Conditions @ | 5% of SUBTOTAL | | | 119,904 |
| Finishes @ | 2% of SUBTOTAL | | | 47,962 |
| Electrical @ | 10% of SUBTOTAL | | | 239,809 |
| Instrumentation & Controls @ | 5% of SUBTOTAL | | | 119,904 |
| Yard Piping @ | 12% of SUBTOTAL | | | 287,771 |
| SUBTOTAL - Percentage Costs Only = 34% of SUBTOTAL | | | | |
| SUBTOTAL - Known and Percentage Costs Only | | | | $2,398,088 |
| Mobilization @ 5% of SUBTOTAL - Known + % | | | | 119,904 |

Subtotal 2,517,992

3.2.3 Alluvial Groundwater Remediation
ALLUVIAL GROUNDWATER PROGRAM
COST INCLUDED IN Section 3.3.3 Remedial Monitoring

# PRELIMINARY

HARDAGE INDUSTRIAL WASTE SITE
CRINER, OKLAHOMA
EPA REMEDY WITH EXCAVATION OPTION

| ITEM | QUANTITY | UNIT MEASURE | UNIT COST | EXTENDED COST | |
|---|---|---|---|---|---|
| Section 3 - DETAILED REMEDY DESCRIPTION | | | | | |
| 3.3 Other Remedial Features | | | | | |
| 3.3.1 Remedial Support Facilities | | | | | |
| GENERAL | | | | | |
| Bonds and Insurance (2% of Construction Subtotal) | 1 | LS | $600,000 | $600,000 | |
| Equipment Mob/Demob (0.5% of Construction Subtotal) | 1 | LS | 150,000 | 150,000 | |
| Community Relations | | | | | |
| Labor | 216 | HRS | 45.00 | 9,720 | |
| Materials | 1 | LS | 10,000 | 10,000 | |
| Utility Service | | | | | |
| Telephone, water, electric | 1 | LS | 58,800 | 58,800 | |
| Subtotal | | | | | $828,520 |
| SITE SUPPORT | | | | | |
| Health/Safety Program | 1 | LS | 209,000 | 209,000 | |
| Air Monitoring | 1 | LS | 171,100 | 171,100 | |
| Project Administration | 1 | LS | 65,000 | 65,000 | |
| Subtotal | | | | | 445,100 |
| SUPPORT FACILITIES | | | | | |
| Construction Office | 1 | LS | $20,000 | $20,000 | |
| Restroom Trailer | 1 | LS | 21,800 | 21,800 | |
| Guard Station | 1 | LS | 10,000 | 10,000 | |
| Guard Service | 1 | LS | 101,430 | 101,430 | |
| Equipment Maint. Shop | 1 | LS | 136,240 | 136,240 | |
| Storage Shed | 1 | LS | 9,000 | 9,000 | |
| On Site Laboratory | 1 | LS | 809,300 | 809,300 | |
| Medical Services Station | 1 | LS | 155,400 | 155,400 | |
| Meterological Station | 1 | LS | 6,700 | 6,700 | |
| Decontamination Stations | 1 | LS | 489,100 | 489,100 | |
| Roadways | 1 | LS | 204,700 | 204,700 | |
| Subtotal | | | | | 1,963,670 |

# PRELIMINARY

HARDAGE INDUSTRIAL WASTE SITE
CRINER, OKLAHOMA
EPA REMEDY WITH EXCAVATION OPTION

| ITEM | QUANTITY | UNIT MEASURE | UNIT COST | EXTENDED COST | |
|---|---|---|---|---|---|
| Section 3 - DETAILED REMEDY DESCRIPTION | | | | | |
| 3.3 Other Remedial Features | | | | | |
| 3.3.2 Surface Water Controls | | | | | |
| STORMWATER CONTROL | | | | | |
| Retention Pond | | | | | |
| Excavation | 4,000 | CY | $3.00 | $12,000 | |
| Backfill | 4,000 | CY | 5.00 | 20,000 | |
| Spillway | 1 | LS | 10,000 | 10,000 | |
| Liner | 142,000 | CY | 1.00 | 142,000 | |
| Discharge Line | | | | | |
| 4" HDPE Line | 800 | LF | 15.00 | 12,000 | |
| Subtotal | | | | | $196,000 |
| 3.3.3 Remedial Monitoring | | | | | |
| MONITORING PROGRAM | | | | | |
| Monitoring Well Installation | 6 | EA | $3,000 | $18,000 | |
| Monitoring Piezometers | 31 | EA | 750 | 23,250 | |
| Subtotal | | | | | 41,250 |
| 3.3.4 Institutional Controls | | | | | |
| INSTITUTIONAL CONTROLS | | | | | |
| Deed Restrictions | | | | | |
| Legal Fees | 1 | LS | $50,000 | $50,000 | |
| Field Markers | 25 | EA | 250 | 6,250 | |
| Easements & Property Purchases | | | | 552,000 | |
| Subtotal | | | | | 608,250 |

# PRELIMINARY

HARDAGE INDUSTRIAL WASTE SITE
CRINER, OKLAHOMA
EPA REMEDY WITH EXCAVATION OPTION

| ITEM | QUANTITY | UNIT MEASURE | UNIT COST | EXTENDED COST | |
|---|---|---|---|---|---|
| Section 3 - DETAILED REMEDY DESCRIPTION | | | | | |
| CONSTRUCTION SUBTOTAL | | | | | $28,306,838 |
| CONTINGENCIES | | | | | |
| Bid Contingency | 15% | | | 4,246,026 | |
| Scope Contingency | 20% | | | 5,661,368 | |
| Subtotal | | | | | 9,907,393 |
| CONSTRUCTION TOTAL | | | | | $38,214,231 |
| IMPLEMENTATION COSTS | | | | | |
| Engineering Design | 10% | | | 3,821,423 | |
| Permitting and Legal | 7% | | | 2,674,996 | |
| Services During Construction | 10% | | | 3,821,423 | |
| Subtotal | | | | | 10,317,842 |
| TOTAL CAPITAL COST Based on October 1988 Dollars | | | | | $48,532,073 |
| Engineering News Record Construction Cost Index | | | | | |
| Dallas September 1989 3189 | | | | | |
| Dallas October 1988 3185 | | | | | |
| Multiplier to change base to September 1989 = 1.0013 | | | | | |
| TOTAL CAPITAL COST Based on September 1989 Dollars | | | | | $48,595,165 |
| OPERATIONS & MAINTENANCE COSTS | | | | | 14,309,500 |
| Present Worth of $661,900 Annual O&M Costs assuming 5% Interest Rate over 30 years and $639,700 Annual O&M Costs assuming 5% over 8 years | | | | | |
| TOTAL CAPITAL COST Including Operations & Maintenance | | | | | $62,904,665 |